JUST GEOLOGY

FROM THE PAGES OF ENVIROMENTAL NEWS

Mississippi Department of Environmental Quality

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The mission of the Mississippi Department of Environmental Quality is to safeguard the health, safety, and welfare of present and future generations of Mississippians by conserving and improving our environment and fostering wise economic growth through focused research and responsible regulation.

Volume 11 Issue 1. pages 1-2 January 2016

The Geology of Mississippi Available for Ordering

David T. Dockery III, RPG, Office of Geology

The Geology of Mississippi authored by David Dockery (MDEQ Office of Geology) and David Thompson (Plum Creek Timber Company and formerly of MDEQ) is now available for pre-order. The book, a collaborative publication of MDEQ and the University Press of Mississippi (UPM) should be available mid-February.

The Geology of Mississippi is a must-have book for anyone working in, or interested in, the field of earth sciences. The hard-bound book contains a foreword by Governor Phil Bryant and is a comprehensive compilation of the state's geology arranged by subject matter and chronologically from Mississippi's oldest to youngest geologic formations. It provides an updated geologic reference for economic minerals, oil and gas production and exploration, environmental protection and remediation, geological engineering, soil science, groundwater resources, and academic studies. It is the largest book published to date by UPM with 751 pages and 1099 figures, most of which are in color.

Contracting with UPM included the assistance of their professional staff such as science editor Lisa Brousseau of Milwaukie, Oregon, to edit the text, to change the style from scientific to a publishing format, to improve the book's organization, and to diplomatically weed out "rabbit trails." The edit phase took several months of a cooperative effort in locating and fixing errors in the text, and much work was done in MDEQ's library to correct or find reference citations. The book design and layout were done by Alcorn Publication Design in Graeagle, California, and the book was indexed by Edwin Fontanilla of San Diego, California. See the flyer on the following page for ordering and pricing details.

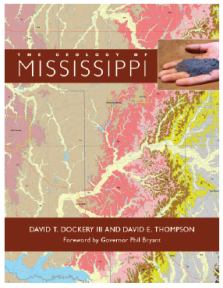
The Geology of Mississippi

David T. Dockery III and David E. Thompson
Foreword by Governor Phil Bryant

The Geology of Mississippi is an encyclopedic work by authors with extensive experience in Mississippi's surface geology mapping program. It brings together published work, unpublished work from agency files, and the authors' experience, both in personal field work and in collaboration with experts from around the word.

With over a thousand images, the voluminous text relates ways in which Mississippi's geology has contributed to the understanding of global events, such as the extinction of the dinosaurs and the first occurrence of tiny primates. Fossil illustrations include Devonian trilobites, Mississippian scale trees, Pennsylvanian brachiopods, Cretaceous dinosaur bones, Paleocene lignite and petrified wood, Eocene seashells and the excavation of fossil whales, Oligocene marine fossils and rare land mammal finds, Miocene plants and animals, Paleozoic marine fossils, and the bones of giant ice-age mammals. The text is arranged by geologic age.

Economic minerals cited in the book include oil and gas (both methane and carbon dioxide), lignite, dimension stone, crushed stone, sand and gravel, various clay deposits, limestone, and potential economic deposits of bauxite, heavy minerals, and iron ore. Groundwater is Mississippi's most valuable natural resource and supplies over 90 percent of the state's public and industrial water supply and most of the state's irrigation supply for agriculture and catfish ponds. Mississippi's surface geology causes the state's fertile and not-so-fertile soil types responsible for foundation and infrastructure substrates that range from stable to failure-prone due to expansive clays. Finally, *The Geology of Mississippi*, coupled with site-specific surface geologic maps, provides information for the wise use of land and the environmental protection of the state's resources.



The first comprehensive treatment of the state's fascinating geological history

David T. Dockery III, Clinton, Mississippi, is a registered professional geologist and the Surface Geology Division Director for the Mississippi Department of Environmental Quality. His work has appeared in *Mississippi Geology*, *Palaios: Nature*, *Paläontologie*, and *Compass*, among others. **David E. Thompson,** Jackson, Mississippi, is a registered professional geologist and supervising geologist in the Surface Geology Division at the Mississippi Department of Environmental Quality. His work has appeared in *Geological Society of America*, *Journal of the Mississippi Academy of Sciences*, and *Mississippi Geology*, among others.

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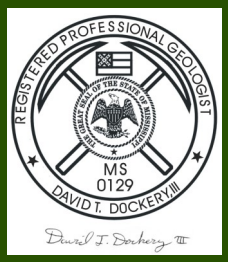

Geoarchaeology

David T. Dockery, RPG, Office of Geology, and Vin Steponaitis, Director of the Research Laboratories of Archaeology, University of North Carolina at Chapel Hill

Geoarchaeology is the use of geologic techniques to examine topics which inform archaeological knowledge and thought. Archaeologists frequently bring stone artifacts to the Surface Geology Division of MDEQ's Office of Geology with the questions: "What is this rock, and where did it come from?" Stone artifacts made from Mississippi bedrock have been found in other states, especially sedimentary quartzite from the Tallahatta Formation. James Starnes and David Thompson (Office of Geology) recently found an ancient quartzite tool-making quarry in the Tallahatta Formation in Newton County with associated debitage (flaked material produced in chipping stone tools). Thus, archaeology joins environmental studies, construction activities, mineral resource investigations, and geologic hazards as areas where staff's geological expertise is applied.

In 1996, Dockery and Steponaitis met at the Mississippi Department of Archives and History in Jackson where a number of effigy pipes from various locations had been assembled based on the fact that they were composed of a similar-looking limestone (see "Effigy Pipes Made of Glendon Limestone from Mississippi" in the November 2013 issue of MDEQ's *Environmental News*). Effigy pipes are carved pipe bowls depicting people or animals or both. Dockery identified some ten of the pipes as made of Glendon Limestone, which probably came from Native American sites in the Vicksburg area. Steponaitis asked, "How do you know that?" He was then shown the wafer-shaped fossils in the limestone belonging to a group of large Foraminifera of the species *Lepidocyclina supera*, a guide fossil to the Glendon Limestone and Byram Formation. This started a collaboration using geoarchaeology to examine other effigy pipes in the Harvard Museum, The Cultural Resources Center of the Smithsonian Museum in Washington, D.C., the Grand Village of the Natchez Museum in Natchez, the Mississippi Department of Archives and History, and private collections. Another Glendon Limestone pipe was studied by the authors at the Gilcrease

Museum in Tulsa, Oklahoma (*Gilcrease Journal*, 2014, volume 11, number 1, p. 36-45). Figure 1 shows a Glendon Limestone effigy pipe recently examined in the National Museum of Natural History collection (the Arkansas Ht Springs cat pipe) and the cross section of the *Lepidocyclina supera* used in its identification.

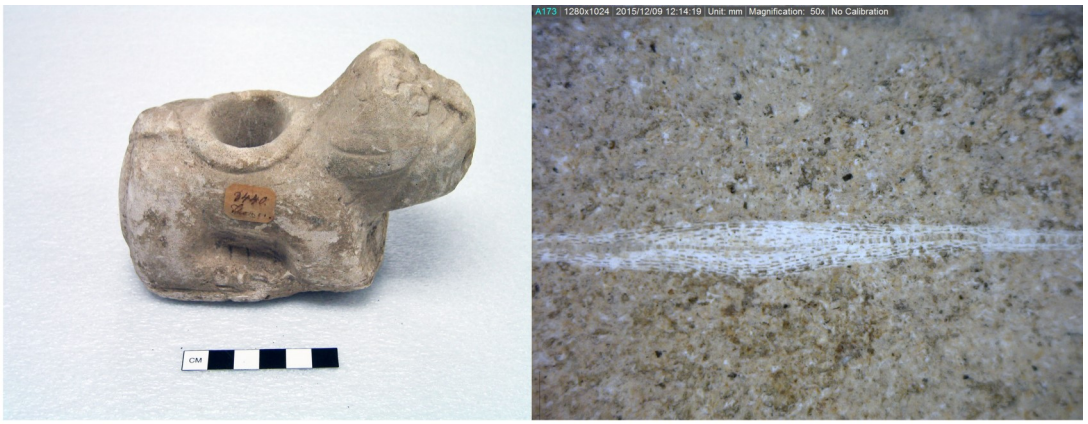

Figure 1. Left, the Arkansas Hot Springs cat pipe in the National Museum of Natural History. Right, Cross section of *Lepidocyclina supera* in the Glendon Limestone on the pipe's surface. Pictures taken on December 8, 2015.

Mississippi effigy pipes were also carved from sandstone, several of which are believed to have been carved from the Catahoula Sandstone of southwestern Mississippi. Our help was again requested. These pipes lack fossils and must be identified by petrographic means. James Starnes gave the three key features of Catahoula Sandstone as opal cement, scattered black chert pebbles and/or sand grains, and angular sand grains. These key features were put to the test on a whirlwind, foundation-funded, tour by planes, trains, subways, and cars from December 7 to 9, 2015, to examine sandstone effigy pipes in five museums in three states in three days, including: (1) the American Museum of Natural History in New York, (2) the Brooklyn Museum (3) the University of Pennsylvania Museum in Philadelphia, (4) the Smithsonian's National Museum of the American Indian Cultural Resources Center, and, (5) the Museum Support Center in Suitland, Maryland. Figure 2 shows staff (left) and effigy pipes studied at the American Museum of Natural History. Figure 3 shows staff and an effigy pipe studied at the Brooklyn Museum. Figure 4 shows staff and effigy pipes studied at the University of Pennsylvania Museum. Figure 5 shows effigy pipes studied at the Cultural Resources Center.

Figure 2. Left, American Museum of Natural History staff (front to back) Anibal Rodriguez, Nell Murphy, and Adam Watson. Right, sandstone effigy pipes studied at the museum. Pictures taken on December 7, 2015.

Figure 3. Left, Nancy Rosoff, Brooklyn Museum curator of The Arts of the Americas (far left) and Anibal Rodriguez (far right). Right, pipe studied with hand-held digital microscope and laptop computer. Pictures taken on December 7, 2015.

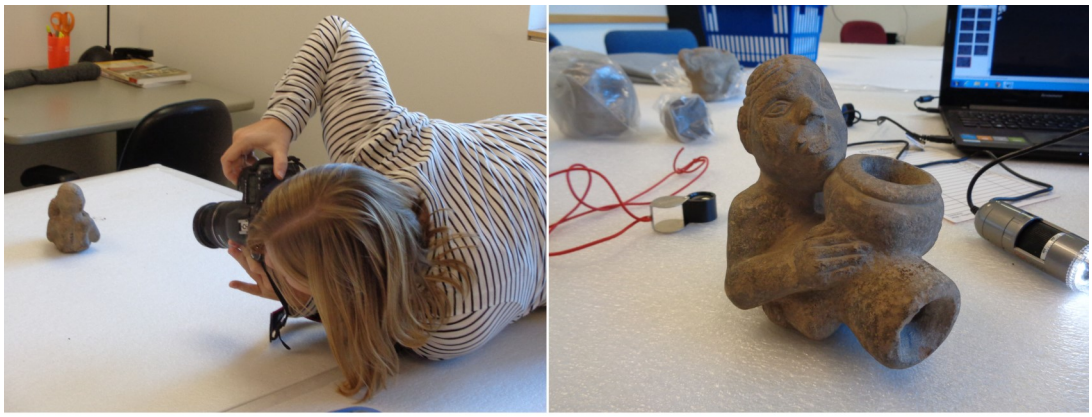

Figure 4. Left, Meg Kassabaum, Assistant Professor of Anthropology at the University of Pennsylvania and Assistant Curator, American Section, University Museum, photographs a sandstone effigy pipe to be studied. Right, closeup of effigy pipe at the Penn Museum. Picture taken on December 8, 2015.

Figure 5. Left, entrance to the Smithsonian's Cultural Resources Center in Suitland, Maryland, just outside of Washington, D. C. Right, cart with stone effigy pipes to be studied. Pictures taken on December 8, 2015.

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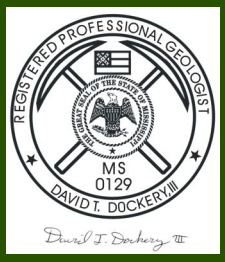


The January 2016 Mississippi River Flood

David T. Dockery III, RPG, and Robert T. Berry, RPG, Office of Geology

Floods are the number one natural disaster in the United States as measured in property loss, insurance costs, and in weather-related deaths. It is also a geological event that sculpts the landscape and deposits geological formations such as those mapped by the Surface Geology Division.

Flooding on the Mississippi River is a repetitive event as seen in the winter Mississippi River flood of 2016, which reached the approximate height of the April 2008 flood, as measured from flood crests in Vicksburg (figures 1-3) and Natchez (Figure 4). This spring-like flood event was associated with: (1) a strong El Niño pattern (warm water in the eastern Pacific), (2) January temperatures 8 to 12 degrees Fahrenheit above normal, and (3) frequent storms that produced heavy rainfall totals in the Mississippi Basin. Late-December 2015 flooding in the upper Mississippi River Valley moved downstream to create high crests in January 2016 along the lower Mississippi River valley.

MDEQ participated as part of the state's response at the Emergency Operations Center at the Mississippi Emergency Management Agency. While there were no significant debris issues as experienced during the 2011 flood, MDEQ staff did respond to several oil and chemical releases from barge collisions on the river.

Figure 1. Tyler Berry at left viewing Mississippi River flood waters against the Vicksburg flood wall at right. Pictures were taken on January 14, 2016.

Figure 2 is a picture of selected high flood crests marked on the Vicksburg floodwall as seen on September 26, 2009. Listed chronologically, these include the floods of 1927 at 56.2 feet, 1929 at 52.9 feet, 1932 at 49.5 feet, 1937 at 53.2 feet, 1945 at 47.5 feet, 1961 at 44.9 feet, 1973 at 51.6 feet, 1983 at 49.3 feet, and 2008 at 51.0 feet. In an 80-year period from 1927 to 2007, eight flood crests are recorded on the wall with the highest at 56.2 feet in 1927. In an eight-year period from 2008 to 2016, there have been four flood crests, occurring in 2008, 2009, 2011, and 2016, worthy of a record mark on the wall, with the highest at 57.1 feet in 2011. The bathtub rings of the 2008 and 2009 (at the level of the 1945 crest) crests can be seen between the markers on the Vicksburg floodwall in the 2009 photograph (Figure 2, left).

Figure 2. Left, Flood crests recorded on the flood wall at Vicksburg after the flood of 2008; picture taken on September 26, 2009. Right, Flood level a day before the crest as seen against the Vicksburg flood wall on January 14, 2016.

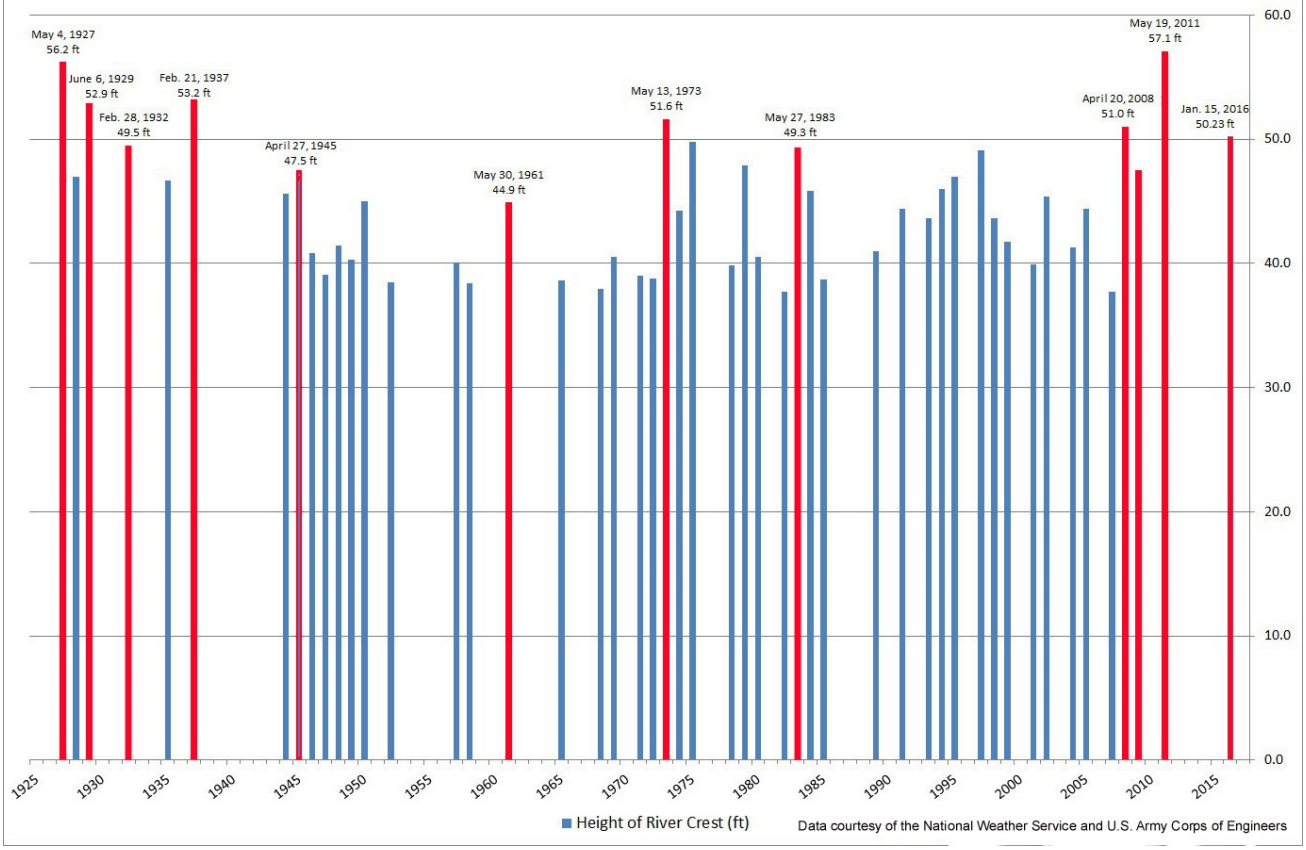
Figure 3. Mississippi River flood crests at the Vicksburg flood wall: Top picture taken April 20, 2008; Middle picture on May 19, 2011; Bottom picture on January 14, 2016.

Figure 4 shows a gate at Natchez Under the Hill as a reference marker for the flood crests of 2008 (top), 2011 (middle), and 2016 (bottom). The January 17, 2016, winter flood crest at 56.7 feet was the fifth highest on record, a little less than the April 2008 spring flood crest of 57.03 feet, but still a couple of inches higher than the 1927 flood. During the 2016 crest, 1.8 million cubic feet of water per second flowed past Natchez. The picture at the bottom of Figure 4 was taken a day after the crest. Pictures of the Vicksburg flood crest in figures 1-3 were taken a day before the actual flood crest on Friday January 15, 2016, at 50.23 feet, a little lower than the 2008 flood at 51.0 feet. At this time some 1.7 million cubic feet of water per second flowed past Vicksburg. At this time the Mississippi River became the second largest river in the world in regard to discharge, eclipsing the Congo River with an average discharge at its mouth of 1.4 million cubic feet per second.

Figure 4. Natchez Mississippi.

Figure 5 (see below) shows significant Mississippi River flood crests at Vicksburg from 1925 to the present as recorded by the National Weather Service. Those crests recorded in paint on the Vicksburg flood wall and those of similar height from 2008 to 2016 are shown in red. The cluster of high flood crests from 2008 to 2016 is similar to that from 1927-1937, indicating recent floods to be part of the natural ebb and flow of high water on the Mississippi River.

Figure 5: Historic Crests of the Mississippi River at Vicksburg, Mississippi (1925 - Present)



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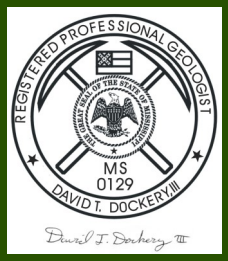

MDEQ Geologists Participate in the 2016 Gem and Mineral Show and the Fossil Road Show

David T. Dockery III, RPG, Office of Geology

The 57th Annual Gem and Mineral Show, sponsored by the Mississippi Gem and Mineral Society, was well attended on February 27 and 28 at the Trade Mart Building in Jackson. MDEQ's Office of Geology had a booth at the event as did the geology departments of the University of Mississippi, Mississippi State University, and the University of Southern Mississippi.

Sitting at a booth is always more fun with good company, and some made it a family affair (Figure 1). The show was a good opportunity to meet the public, distribute literature published by the Office of Geology, and identify the latest rock, mineral, and fossil finds from Mississippi.

A selection of interesting finds is shown in Figure 2. Figure 2A is the fossil dental plate of a ray showing wear at the front end (at right in A1) from crushing shells of clams and crabs and such. Worn front teeth are replaced as those behind move forward. This find came from a boulder of limestone in the Pearl River south of the Old Byram Swinging Bridge. Figure B is a knapped preform artifact made of ironstone, most likely of the mineral goethite or limonite. Figure C is a large chert pebble showing the truncated branches of an extinct trepostome bryozoan. Figure D is a cobble-size concretion with a rainbow of jasper bands in greenish-gray and red. Figure E was described by the collector as an exploded agate, not a bad portrayal of its geologic description as a brecciated agate. Figure F is the concave valve of a productid brachiopod preserved in carnelian, a red agate. Figure G was described by the collector as a black agate, a color not common to local agates. The exterior bands show the dark color.

An annual favorite at the show is the traveling Rock Food Table exhibited by the Gulf Coast Gem and Mineral Society in Corpus Christi, Texas (Figure 3). All the delicious-looking items are stones of one kind or another.

Figure 1. Staffing the Office of Geology booth, a family affair. Left, James Starnes with wife Laurie and daughters Abby (left) and Gracie (right). Right, Andrew Newcomb with wife Stacy.

Figure 2. Interesting finds presented at the Office of Geology booth. A. Ray dental plate from the Byram Formation south of the Old Byram bridge. B. Preform artifact knapped from ironstone. C. Trepostome bryozoan branches. D. Rainbow jasper concretion. E. Brecciated agate. F. Carnelian productid brachiopod. G. Black agate.

Figure 3. George and Judy Johnson from Lake Odessa, Michigan, view the dinner table set in stone, a popular exhibit at the Gem and Mineral Rock Show.

The 13th Annual Fossil Road Show was held at the Mississippi Museum of Natural Science in Jackson on March 5. A team of experts, including MDEQ staff, was assembled to identify fossils brought in by the public. Figure 4 at left shows dinosaur expert James Lamb of the University of West Alabama. At right is MDEQ Office of Geology geologist James Starnes with his daughter Abby. In Figure 5 at left is Mississippi Department of Archives and History's Robin Person representing Historic Jefferson College at Washington, near Natchez, in Adams County. At right in the figure is a binder with details concerning B. L. C. Wailes, who received his formal education at Jefferson College and became a trustee of the college in 1824. In 1838, Jefferson College and Washington Lyceum petitioned the Mississippi Legislature to fund a geological survey of the state. This legislation passed in the spring of 1850, and funds for that purpose went to the recently founded University of Mississippi at Oxford to support a professor of chemistry, geology, and agriculture, Dr. John Millington. When Millington could not both teach and do the survey, Wailes was contracted to do the job. Wailes traveled the length and breadth of the state by carriage to make the survey and, in 1854, published a *Report on the Agriculture and Geology of Mississippi*, a book of 371 pages with hand-colored figures.

Figure 4. Left, James Lamb, a dinosaur expert at the University of West Alabama, has been helpful in identifying dinosaur remains from Mississippi. Right, James Starnes and his daughter Abby greet those bringing both rocks and fossils for identification.

Figure 5. Robin Person (left, behind table), MDAH Branch Director of Historic Jefferson College at Washington, Mississippi, displays fossils from the college collection. B. L. C. Wailes (right, binder) created the first fossil collection at Jefferson College and published the first book on the geology of Mississippi in 1854.

In Figure 6 at left, representing the Department of Geology and Geological Engineering at the University of Mississippi, are Louis Zachos and his wife Marla. Dr. Zachos is an expert in fossil echiniods; Marla holds degrees in law and geology. At right is Robert Seyfarth, a retired employee of MDEQ's Office of Land and Water Resources, exhibiting his collection of fossils from the Natchez area. In Figure 7 at left is museum volunteer Emily Dear holding a copy of the newly published book *The Geology of Mississippi*. Emily and husband Dr. Dave Dear are featured on page 490 in Figure 853 of that book beside a plaster jacket containing the skull of a large hippo-like land mammal named *Metamynodon* at a site on property they once owned on the Big Black River at Edwards. This site (at right in Figure 7) is so important that it covers a seven-page spread in the section on the Early Oligocene Byram Formation. Figure 8 shows the use of *The Geology of Mississippi* in identifying specimens brought by the public to the Fossil Road Show.

Figure 6. Left, Louis Zachos and wife Marla, representing the Department of Geology and Geological Engineering at the University of Mississippi. Dr. Zachos is an echinoid expert, and Marla is both a geologist and attorney. Right, Robert Seyfarth, retired engineer from MDEQ's Office of Land and Water Resources, displays fossils from Natchez, Mississippi.

Figure 7. Left, Emily Dear, a volunteer at the Mississippi Museum of Natural Science, holds a just-published copy of *The Geology of Mississippi*. Right, in this book is a picture of Emily and her husband Dr. Dave Dear (heart surgeon, figure 853 in book) beside a plaster jacket containing the skull of a *Metamynodon*, a large land mammal, excavated from property they once owned at Edwards, MS.

Figure 8. *The Geology of Mississippi* book was put to use at the Fossil Road Show in identifying specimens brought in by the public. At left is a fossil snake vertebra from the Cane River Formation in Louisiana compared to a specimen of *Palaeophis virginianus* from Mississippi in the book. At right is the fossil conch shell *Galeodea millsapsi* from the Moodys Branch Formation in Louisiana compared to others from Mississippi figured in the book.

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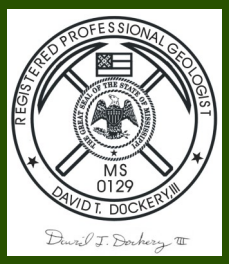

Paleontological Research Institution Studying Ancient Molluscan Diversity at MDEQ

David T. Dockery III, RPG, Office of Geology

What does MDEQ's Office of Geology have that the Paleontological Research Institution in Ithaca, New York, does not?--Molluscan fossils from the upper Hatchetigbee Formation. A diverse molluscan fauna is present in the upper Hatchetigbee Formation at its type locality at Hatchetigbee Bluff on the Tombigbee River in Washington County, Alabama (Figure 1). This section is often overlooked by those collecting fossils closer to the river level at the base of the bluff where fossiliferous beds are dominated by the clam *Venericardia (Venericor) hatcheplata* and a few gastropod species.

The Office of Geology's fossil collections date to the beginning of the agency's bulletin series in 1907 and contain everything from large mastodon bones to fossil seashells and microscopic tests of one-celled marine animals called Foraminifera. These collections include specimens from neighboring states and are studied by paleontologists worldwide. They are useful in the study of the history of life on earth and in correlating and mapping geologic formations.

Figure 1. Steve Tracy (left) and David Ward (right) examining a concretionary boulder from the shell-hash deposit of the upper Hatchetigbee Formation at its type locality at Hatchetigbee Bluff on the Tombigbee River in Washington County, Alabama.

The Paleontological Research Institution (PRI) was founded by Gilbert D. Harris, a Cornell University Professor and the fourth state geologist of Louisiana, in 1932. Harris and subsequent director Katherine Palmer collected and published fossils from the Gulf Coast states including Mississippi. Today, the institution's collections contain nearly three million specimens (one of the 10 largest in the U.S.), some of which are exhibited in an 8,000-square-foot museum.

PRI post doc student Carlie Pietsch visited MDEQ's North West Street office from March 30 to April 1, 2016, to identify and measure the upper Hatchetigbee Formation mollusks in the Office of Geology collections (Figure 2). She brought with her type specimens from the PRI collection that the Office of Geology wished to photograph—part of a working relationship the office has maintained since 1977 with the publication of Bulletin 120 on fossil mollusks of the Moodys Branch Formation in Mississippi. Type specimens figured in this bulletin and in Bulletin 122 were placed in the PRI collections. This cooperative relationship was so important that the University Press of Mississippi requested PRI Director and Cornell University Professor Warren Allmon to review/endorse *The Geology of Mississippi*. This endorsement appears on the book's back cover. Books are available at the Office of Geology Publication Sales Office on the first floor of the 700 North State Street Building in Jackson.

Figure 2. Post doc student Carlie Pietsch studying fossil mollusks from the upper Hatchetigbee Formation at MDEQ Office of Geology's North West Street Office.

Just Geology

A compilation of articles from the Office of Geology for this newsletter covering the years 2014 and 2015 is available at this link:

http://www.deq.state.ms.us/MDEQ.nsf/pdf/Geology_JustGeology2014-2015/$File/JustGeology2014-2015.pdf?OpenElement.

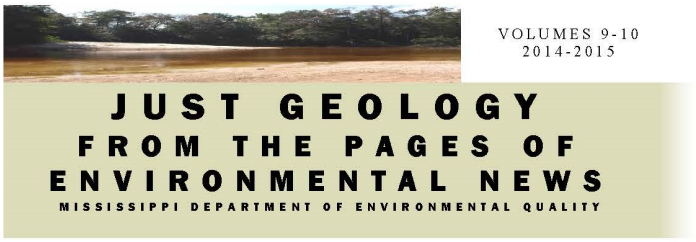

Figure 6. Top: *Calyptraphorus stamineus* (Conrad, 1856) from the Moodys Branch Formation (38 million years old) in pile borings at the construction site of the Museum of Mississippi History in Jackson, Mississippi. Web images: Bottom left: Living relative from the Japan and South China Sea, *Tibia martinii* Marrat, 1877. Bottom right: Living relative from the North Indian Ocean and Red Sea, *Tibia insulaechorab* Roding, 1798.

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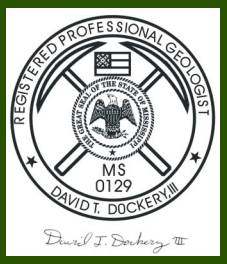


Paleontological Resources at the Vicksburg National Military Park

David T. Dockery III, RPG, Office of Geology

In April of 2016 Sara Strickland, Natural Resource Manager at the Vicksburg National Military Park, contacted MDEQ Office of Geology staff concerning paleontological/geological resources in the area of proposed slope stabilization measures along Mint Spring Bayou. In the past, the Office of Geology has published two bulletins (bulletins 123 and 124) on the fossils found at the type locality of the Mint Spring Formation at a waterfall on Mint Spring Bayou.

The office has also assisted the work of others at this important scientific site. Bulletin 124 (page 8) gives the history of the study of Oligocene-age fossils of the Vicksburg Group in Mississippi. Early fossil collections from the site, according to the U.S. Geological Survey Cenozoic Locality Register, include collections by T. W. Vaughan in 1900, C. W. Cooke in 1912, and O. B. Hopkins. C. W. Cooke named the Mint Spring Formation in 1918 for calcareous sands with well-preserved fossils occurring below the limestone ledges at the Mint Spring Bayou waterfall (Figure 1).

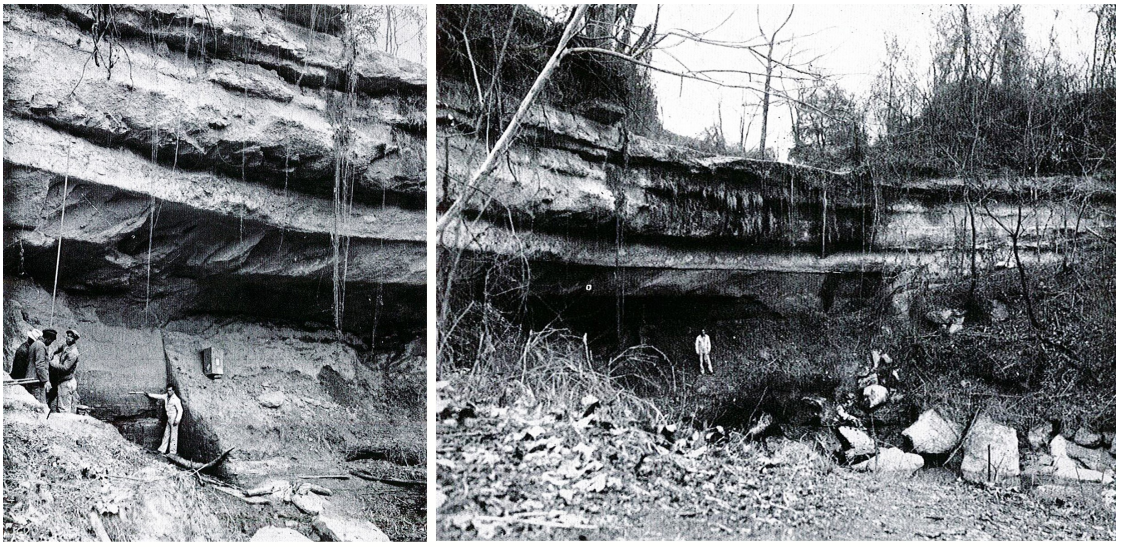


Figure 1. Left, Fred Mellen at right pointing to the contact of the Forest Hill Formation and the overlying Mint Spring Formation. Right, Fred Mellen at the waterfall on Mint Spring Bayou during a dry period with no flow. Both pictures were taken on January 23, 1939.

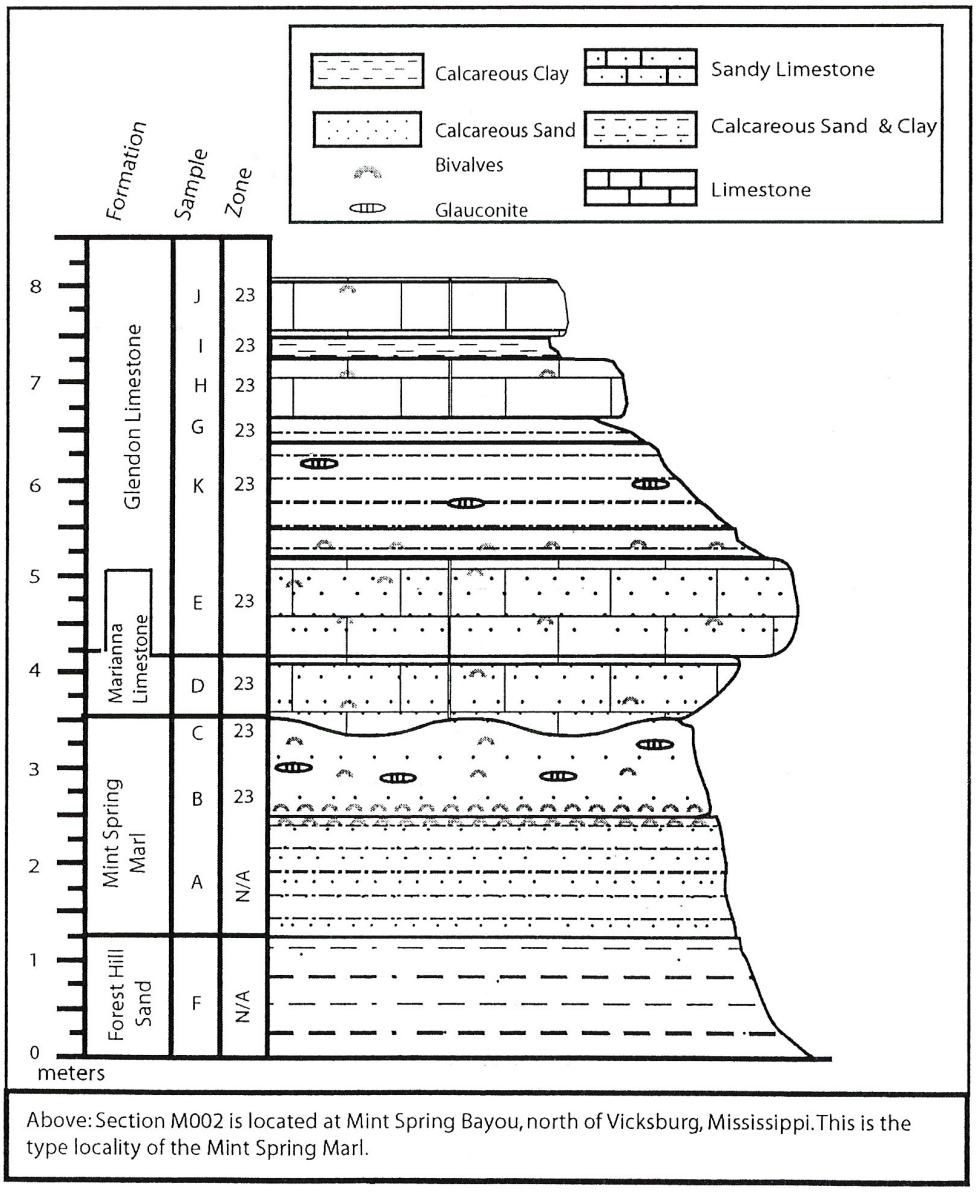
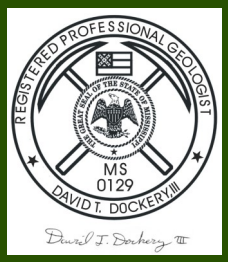


Figure 3. Measured section in meters of the geology exposed at the Mint Spring Bayou waterfall from Chris Hall's masters thesis, p. 89, Figure 40. All marine intervals sampled were assigned to the calcareous nannofossil zone NP 23 of Early Oligocene age.

Figure 4. Views from the top of the retaining walls adjacent to the Mint Spring Bayou waterfall at the Vicksburg National Cemetery. Pictures were taken on October 29, 2011.



The Influence of Geology on the History of Jones County as Portrayed in *Free State of Jones*

David T. Dockery III, RPG, Office of Geology

Jim Kelly, Historical Consultant, *Free State of Jones*

On December 18, 2013, historian Jim Kelly came to the Office of Geology to discuss the influence of geology on the history of Jones County. Kelly was one of eleven historical consultants for the recent movie *Free State of Jones*. Matthew McConaughey (Figure 1) stars in the movie playing the role of Newton Knight, who fought at the Battle of Corinth before deserting with others to his home in Jones County. In 1864, Newt Knight rebelled against the Confederate government with a coalition of freed slaves and former Confederate soldiers and created a "Free State of Jones."

Part of Knight's disillusionment with the Confederate cause was a newly-enacted Mississippi law that exempted fighting-age men of wealthy slave-owning families from the draft, or to use a phrase from the period: "a rich man's war and a poor man's fight."

Figure 1. Left, Matthew McConaughey (left) and director Gary Ross. Right, James Kelly (left) and Gary Ross at the grave of Newt Knight in Jones County.

Kelly was researching whether the weathered bedrock geology in Jones County that limited plantation agriculture was a factor on the geopolitical situation in Knight's time. As provided by the Office of Geology, the state's agricultural wealth at the time resided largely in three geologic belts: (1) the Black Belt overlying Cretaceous Chalk in northeastern Mississippi, (2) the Jackson Prairie overlying the Yazoo Clay across central Mississippi, and (3) the Loess Belt bordering the Mississippi River and its alluvial plain in western Mississippi. As shown in the 1860 Geologic Map of Mississippi by State Geologist Eugene Hilgard (Figure 2), Jones County lies above the Grand Gulf Group, which develops soil more suited to forests and timber than plantation agriculture.

While geology is the foundation for the environment and natural resources, it can also influence larger social and political issues.

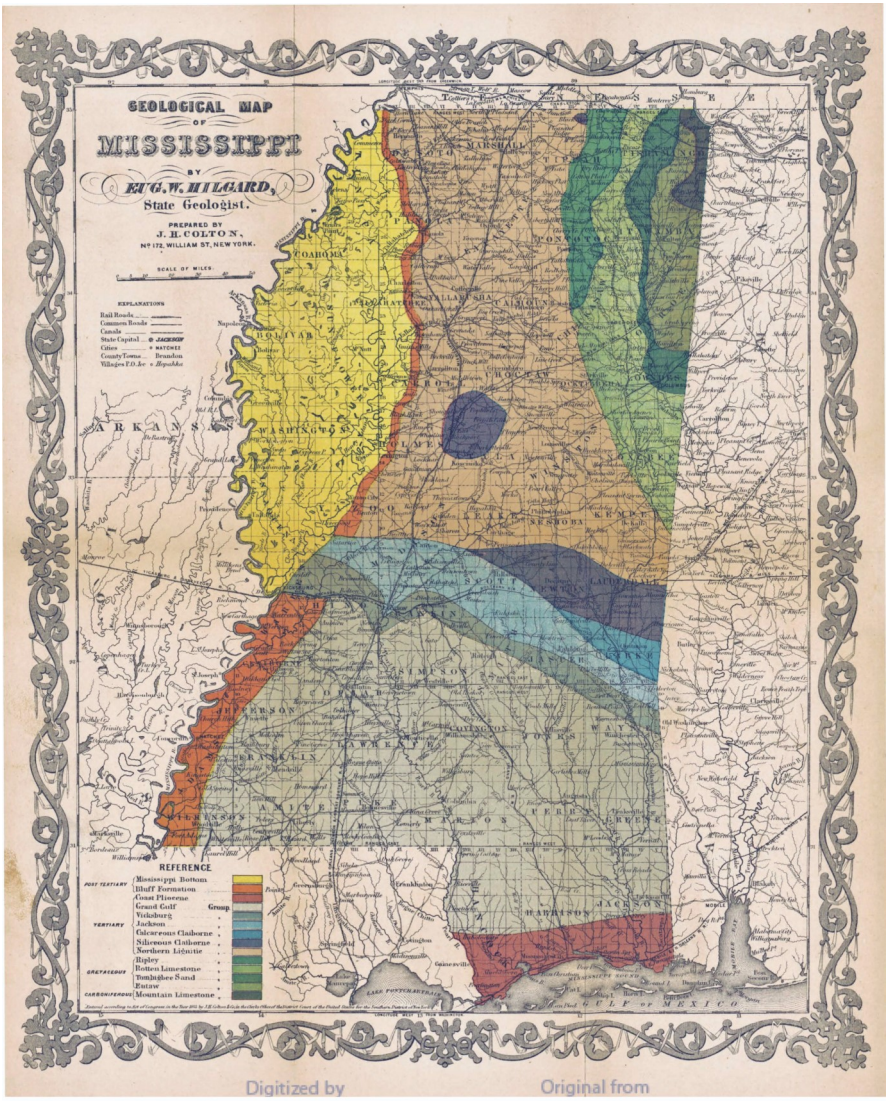


Figure 2. Hilgard's 1860 Geologic Map of Mississippi.

Geology Outreach

Students from the Wyatte Baptist Learning Center in Tate County recently visited the MDEQ offices in Jackson and learned about the importance of Mississippi Geology from James Starnes and David Dockery.

Photos

Top: James Starnes discussed what fossils can be found in Mississippi.

Bottom: David Dockery used the students to demonstrate earthquake waves.

National Fossil Day

David T. Dockery III, RPG, Office of Geology

Mississippi has much to celebrate on National Fossil Day, annually marked on the Wednesday of the second full week in October, and this year it was celebrated on October 12. An important piece of the puzzle in the knowledge of ancient climate, environment, and the history of life on earth, has come from fossil localities in the state. To further interest and research, MDEQ's Office of Geology has published a list of 173 significant fossil sites in Mississippi and two sites in Alabama.

In honor of National Fossil Day, the significance of one locality is mentioned here, Mississippi Geological Survey (MGS) Locality #1. This site, where the Late Eocene Moodys Branch Formation is exposed on Town Creek in south Jackson, has some of the best preserved Late Eocene seashells found anywhere in the world outside of the Paris Basin in France. English geologist Charles Lyell visited the site in 1846 and first placed the formation in his Eocene Epoch, the lower of three Tertiary divisions (Eocene, Miocene, Pliocene) he had described in Europe at this time. B. L. C. Wailes collected from the Town Creek site during his geologic survey of the State of Mississippi and published four plates of fossil shells in 1854 (Figure 1), and, these fossils were named in the same volume by Timothy A. Conrad, who had published the fossil shells of Vicksburg in 1848. In 1856, Conrad named the Jackson Group as a division of the Late Eocene and the Vicksburg Group as Oligocene in age, thus establishing the geologic framework of much of central Mississippi. Other major publications concerning the fossil shells of Town Creek include volume 30 of the Bulletins of American Paleontology by Harris and Palmer in 1946-1947 and volume 120 of the Mississippi Geological Survey bulletin series by Dockery in 1977.

In the transformation of seashells to fossil shells, one of the first attributes a shell loses is its color and color pattern, usually in the first million years or so. The fossil shells at Town Creek are placed at 38 million years old. Thus, they show no color patterns under natural light, but the color patterns of some species fluoresce under ultraviolet light.

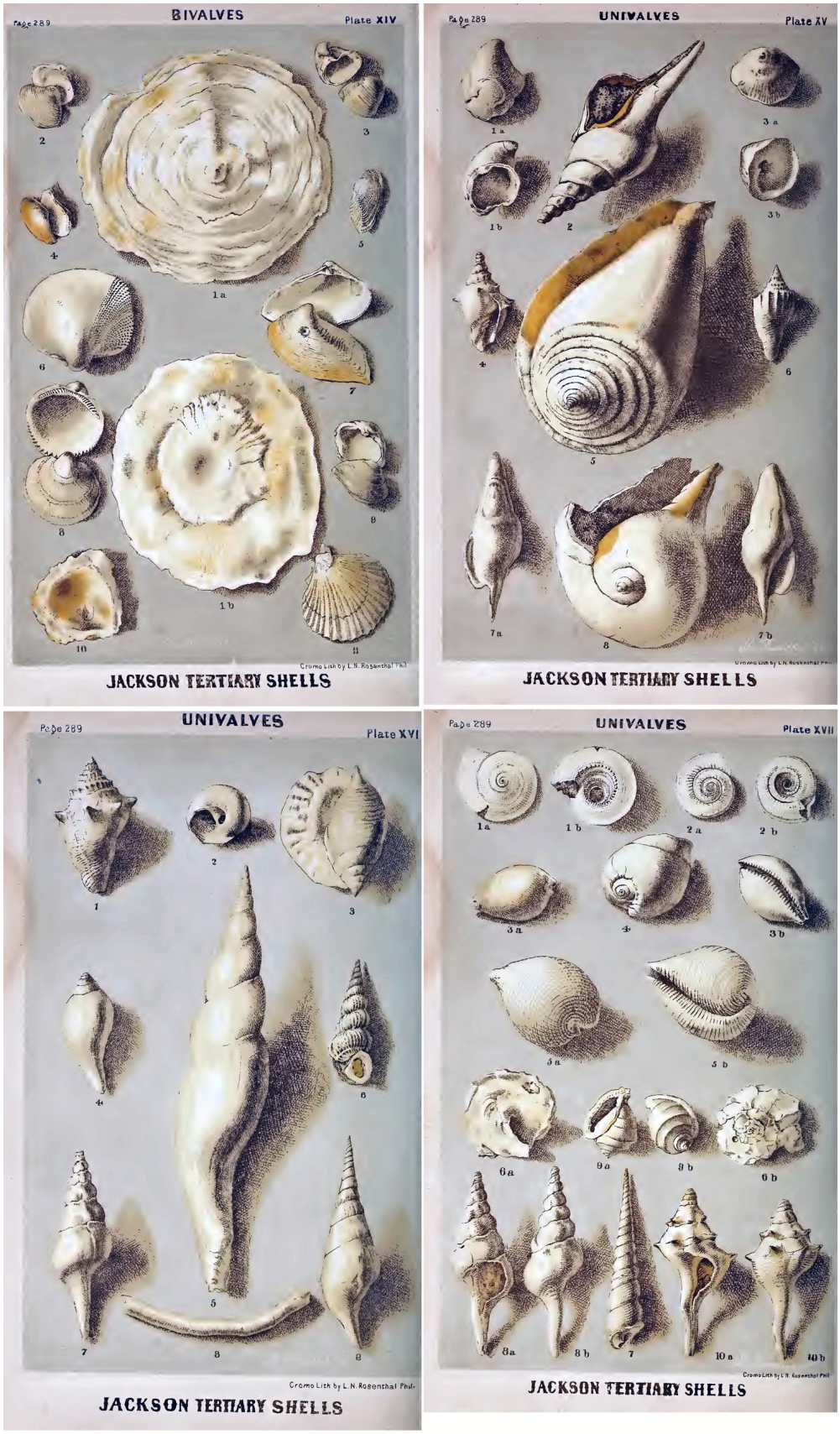


Figure 1. Moodys Branch Formation fossil shells from Town Creek in Jackson figured in 1854 publication by B.L.C. Wailes and named by T. A. Conrad in the same volume.

Figures 2 and 3 show fossil gastropod shells from Town Creek photographed under natural and ultraviolet light. The fluorescent color pattern is compared to that of a Recent Epoch relative. Figures 4 and 5 show fossil clam shells from Town Creek photographed under natural and ultraviolet light in the same manner. The color and color patterns of some living species may show considerable variation. However, the fossils from Town Creek show that, in some cases, related taxa of seashells have maintained the same color patterns over the last 38 million years.

Figure 2. *Platyoptera extenta*, natural light at top, ultraviolet light photograph showing color pattern at bottom left. The Recent strombid *Laevistrombus canarium* at bottom right, showing a similar color pattern.

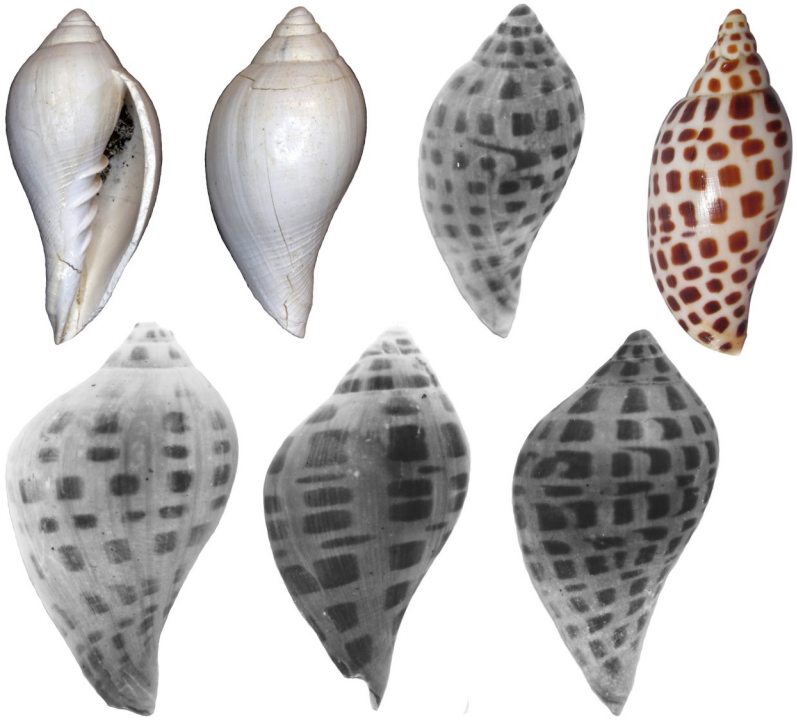


Figure 3. *Caricella polita* in natural and ultraviolet light at top left. Recent specimen of *Scaphella junonia*, the state shell of Alabama, with a similar color pattern at top right. *Caricella subangulata* in ultraviolet light at bottom.

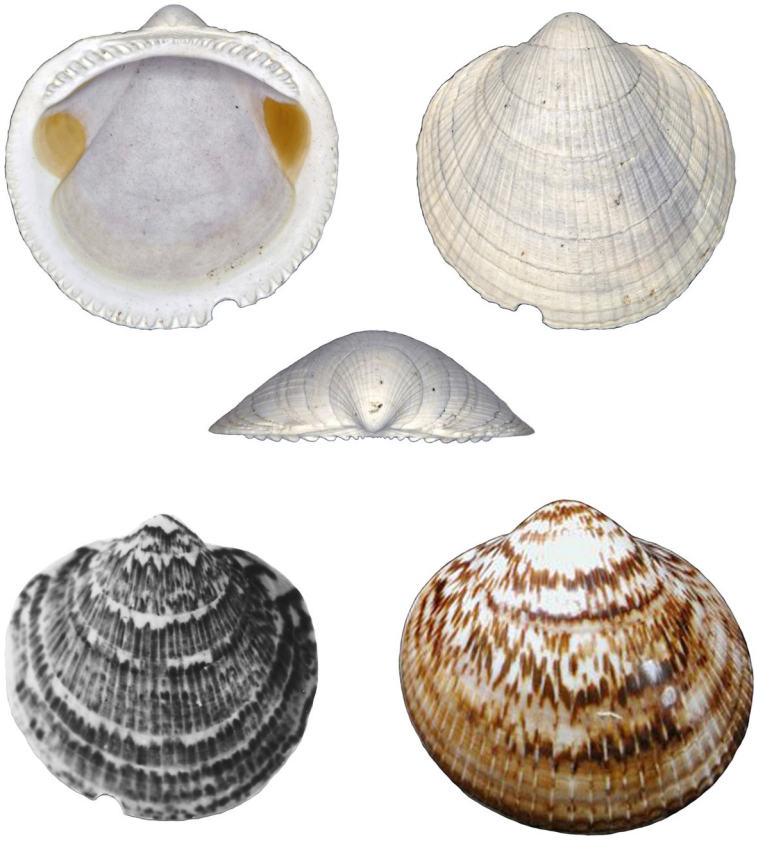


Figure 4. *Glycymeris filosa* in natural light at top and middle and ultraviolet light at bottom left. The Recent *Glycymeris glycymeris* with a similar color pattern.

Figure 5. *Callista annexa* in natural light at top and ultraviolet light at bottom left. The Recent *Callista multiradiata* at bottom right, showing a similar color pattern.

Again, this is just one location in the state taken from a list of significant sites. For more information about this site, or other fossil sites in Mississippi, please contact the MDEQ Office of Geology.

Volume 13 Issue 9, pages 11–12 November 2016

USGS Survey Energy Assessment Team Utilizes MDEQ's Core and Sample Library

David T. Dockery III, RPG, Office of Geology

Paul Hackley, Celeste Lohr, and Javin Hatcherian of the U.S. Geological Survey's (USGS) energy assessment team visited MDEQ's Core and Sample Library in Jackson on November 9 where they collected 45 samples from 20 legacy wells that cut core in the Tuscaloosa Group, especially from the Tuscaloosa marine shale (Figure 1). Their study is to assess the unconventional resources potential of oil production and the sealing properties for carbon sequestration. Unconventional oil and gas production has greatly increased the country's oil and gas reserves and has made the nation less dependent on foreign oil. Domestic production of oil and gas make for a more secure country, thus the need by USGS for a national assessment of the nation's reserves.

Figure 1. Cores from the Tuscaloosa marine shale sampled by the U.S. Geological Survey at MDEQ's Core and Sample Library in Jackson.

Mr. Hackley relayed to us the importance of having access to the MDEQ facility: "Storage and archival of Mississippi's subsurface rock library from oil and gas exploration provides an important service to our agency and others. Without access to your facility and the ability to sample from the rocks stored therein, we could not accomplish our core mission goals."

On November 10, Mr. Hackley gave a presentation on findings from previous core samples taken from the Core and Sample Library at the River Hills Club in Jackson before a monthly meeting of the Mississippi Geological Society (figures 2-3).

The first oil production in Mississippi in 1939 came just before World War II at a critical time in the nation's history when energy was needed for the war effort. Currently, the state's oil production has increased over the last decade with an average production of 68,417 barrels per day in 2015.

Figure 3. Paul Hackley, standing upper left, presenting data obtained from MDEQ's Core and Sample Library and elsewhere at the November 10, 2016, meeting of the Mississippi Geological Society (composite image).

Figure 2. Left to right, Javin Hatcherian, Celeste Lohr, and Paul Hackley at the November 10, 2016, meeting of the Mississippi Geological Society.

#FossilFriday

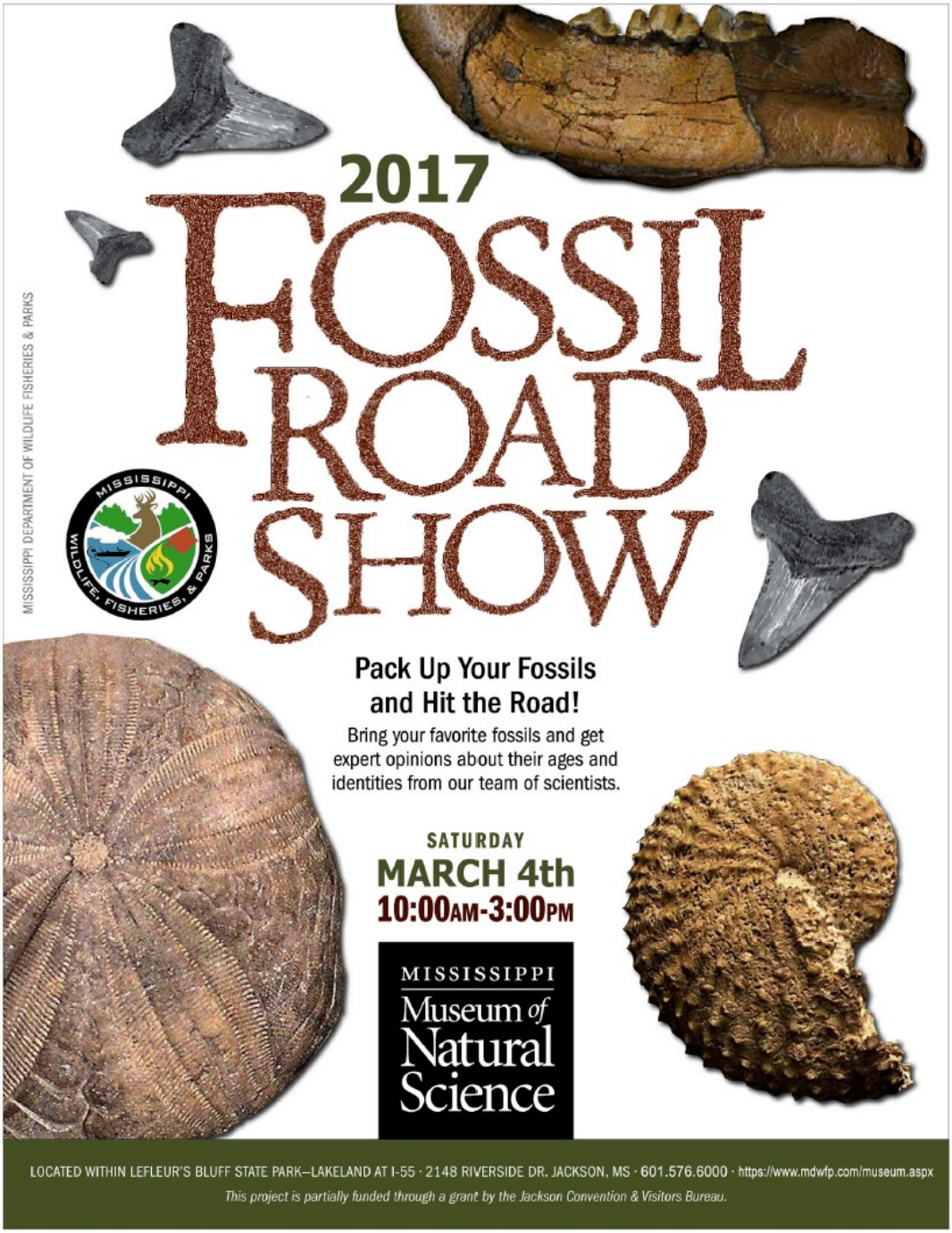
Since National Fossil Day on October 12, MDEQ and its Office of Geology have been posting a Mississippi fossil every Friday on Facebook and Twitter with the hashtag #FossilFriday. The agency recently launched an Instagram account and will post the same fossil photos there. The hashtag is used across social media to highlight interesting fossils.

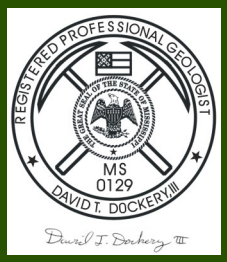
The State of Mississippi, from border to border, contains intriguing and significant fossils that draw researchers from around the country and the world.

Follow along each Friday on Twitter, Facebook, and Instagram!

Ice age Mastodon (Mammut americanum) from the ancestral Mississippi River Pre-loess terrace gravels near Bovina in Warren County. This photo was posted on November 11 for #FossilFriday

MDEQ Geologists will be participating as experts to identify your finds!





MDEQ Staff Participate in 2017 Annual Meeting of the Mississippi Academy of Sciences

David T. Dockery III, RPG, Office of Geology

MDEQ Office of Geology staff participated in the Mississippi Academy of Sciences' 81st annual meeting at the Thad Cochran Center at the University of Southern Mississippi on February 23 to 24. The Mississippi Academy of Sciences (MAS) is one of the top ten academies of sciences in the United States.

The Office of Geology, including when it was known as the Mississippi Geological Survey (MGS), has a long history of contributing to MAS's earliest meetings. In 1942, MGS geologist F. E. Vestal gave a report on "The Geology of Adams County." In the same meeting Millsaps College Professor Dr. J. M. Sullivan gave accounts of: a *Zygorhiza kochii* (fossil whale) found in 1933, a new fossil alcyonarian coral *Eogorgonia sullivani* Hickson, a new fossil helmet shell *Galeodea millsapsi* Sullivan and Gardner, and the first titanothere fossil found east of the Mississippi River *Notiotitanops mississippiensis* Gazin and Sullivan. In 1984, MGS author names on MAS abstracts included David Booth, Darrel Schmitz, William Gilliland, Alvin Bicker, Michael Seal, Curtis Stover, David Dockery, and former State Geologist Fred Mellen.

At this year's annual meeting, MDEQ's James Starnes presented a paper on the contributions of new fossil finds to geologic mapping in southern Mississippi. Notable among these finds are (oldest to youngest): the updip limit of the Late Oligocene *Heterostegina* Limestone found in test holes and cores in the upper Catahoula Formation of Covington County, the Middle Miocene short-legged rhinoceros *Teleoceras medicomutum* in the Hattiesburg Formation of Franklin County, and a Late Miocene neohipparion horse in the Pascagoula Formation of Perry County.

Tyler Berry, also of MDEQ's Office of Geology, was Chair of the Geology and Geography Division, which included papers from faculty and students representing the University of Southern Mississippi (three presentations), Millsaps College (four), Mississippi State University (four), the University of Mississippi (five), and MDEQ's Office of Geology (four). Tyler also presented MAS awards for the Division's best undergraduate and graduate student presentations.

Top: Tyler Berry presented the award for best undergraduate presentation to Brooks Rosandich of Millsaps College.

Bottom: Kaitlin Voll of Ole Miss received the best graduate presentation award.

Geology Outreach — Gem and Mineral Show

The 58th Annual Gem and Mineral Show, sponsored by the Mississippi Gem and Mineral Society, drew large crowds on February 25th and 26th at the Trade Mart in Jackson. MDEQ's Office of Geology had a booth at the event as did the University of Mississippi, Mississippi State University, and the University of Southern Mississippi.

The Gem and Mineral Show is always a good opportunity to meet the public, answer questions, identify rocks and fossils, sell office literature, and a time to interest students and families in the state's natural history.

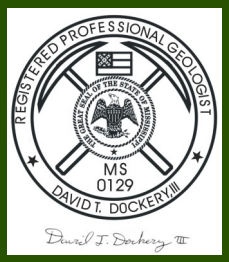
Top: Forensic geology students at Tulane University's Madison campus: Wesley Perry and Kimberly Hawkins at the Office of Geology booth.

Bottom: MDEQ's Barbara Yassin with her daughter Nadia working the booth.

MDEQ geologist James Starnes helping young people identify what they brought.

Geology Outreach — Fossil Road Show

MDEQ geologists also participated in the 14th Annual Fossil Road Show on March 4 at the Mississippi Museum of Natural Science. The show provides an excellent opportunity for the public to bring their "finds" to be identified. MDEQ staff look forward to this event every year to interact with the public and the expectation of some unusual Mississippi fossils.



Mapping the Geology of the Natchez Trace Parkway

David T. Dockery III, RPG, and R. Tyler Berry, RPG, Office of Geology

The Program Manager of the Geologic Resources Division for the National Park Service (NPS), Bruce Heise, is approaching retirement this year. Nearing the end of his tenure, the geology of all of the nation's 270 National Parks have been, or are in the process of being mapped, excluding just two. Both of the two excluded are in Mississippi: the Vicksburg National Military Park (VNMP) and the Natchez Trace Parkway (NATR). Recently MDEQ's Office of Geology, Mississippi State University, and the NPS discussed a cooperative effort to map the geology of the 7.5-minute quadrangle maps that cover the Trace right-of-way (Figure 1). Three of these quadrangles near Kosciusko, Mississippi, will be mapped in the upcoming 2018 Fiscal Year.

Figure 1. Meeting with the National Park Service at MDEQ's 700 Building to discuss a cooperative effort to map the geology of the Natchez Trace Parkway at a scale of 1:24,000. At front table is Tyler Berry, MDEQ Office of Geology (OG). At second table, from left to right, are Dan Irvin of the Geological Survey of Alabama, Bruce Heise of the National Park Service (NPS), Dr. Lisa McInnis of NPS, Deanna Boensch of NPS, and Martha Segura of NPS. At third table, left to right, are Darrel Schmitz of Mississippi State University and Dan Morse (OG).

Following the meeting, a geological field trip was held down the Trace from the Interstate 20 intersection at Clinton to Natchez. The first stop was a "Wildlife Crossing" for the rare Webster's Salamander, which inhabits karst spaces in the Glendon Limestone (Figure 2). The second stop was at Rocky Springs to see the rocky ledges of sandstone in the Catahoula Formation, which formed the base for a perched water table at the town's original spring site (Figure 3).

Figure 2. Glendon Limestone on Lindsey Creek on the east side of the Natchez Trace Parkway and just south of Interstate 20 in Hinds County, Mississippi. Left to right, Bruce Heise (GRD), Tyler Berry (MOG), Dr. Lisa McInnis (NATR), Sara Strickland (VICK), Paul Parrish (MOG), Andrew Newcomb (MOG), and Dr. Darrel Schmitz (MSU). Picture taken on March 23, 2017.

Figure 3. Bruce Heise (left) and Tyler Berry looking at ledges of Catahoula sandstone which formed the floor of a perched water table and spring for the Rocky Springs townsite. Picture taken on March 23, 2017.

Figure 4 shows the status of geologic mapping work for 7.5-minute quadrangles along the southern half of the Trace in Mississippi. Maps published, or soon to be published, as Open File Reports are color-coded in olive green and are/will be available online (http://bit.ly/2pg64cN). A cluster of seven maps is published in the Claiborne County area with the Carlisle Quadrangle being in the center. North of the Jackson area are eleven geologic maps coded in olive green; the first three are scheduled for 2018 and the others are available online.

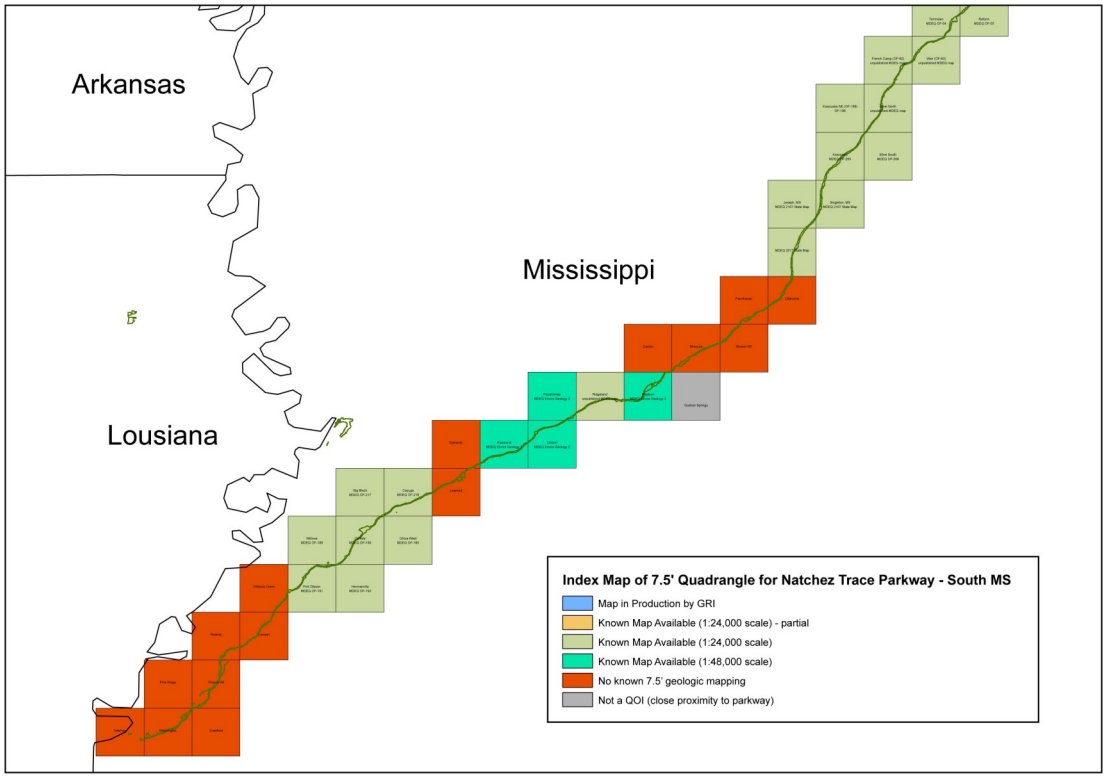


Figure 4. 7.5-minute quadrangle map coverage of the Natchez Trace Parkway in southern and central Mississippi. Olive green colored maps are completed or in progress.

Figure 5 shows the borders of Rocky Springs site on the Carlisle Geological Quadrangle map with the addition of shaded relief. This relief shows the rugged terrain of bedrock strata in the Catahoula Formation above flat alluvial deposits. At higher elevations above the Catahoula are the Hattiesburg Formation and pre-loess terrace deposits. Figure 6 shows the status of geologic maps in northeastern Mississippi, most of which are in progress at some stage or are published. In the southern range of these quadrangles is the Jeff Busby site (Tomnolen Quadrangle, Figure 7) with a scenic view to the east from Little Mountain at the edge of a Wilcox Group cuesta, a ridge developed on the basal sands of the Tuscahoma Formation overlying clay-rich sediments in the Grampian Hills Member of the Nanafalia Formation. Figure 8 shows the view from Little Mountain as taken in July of 1973.

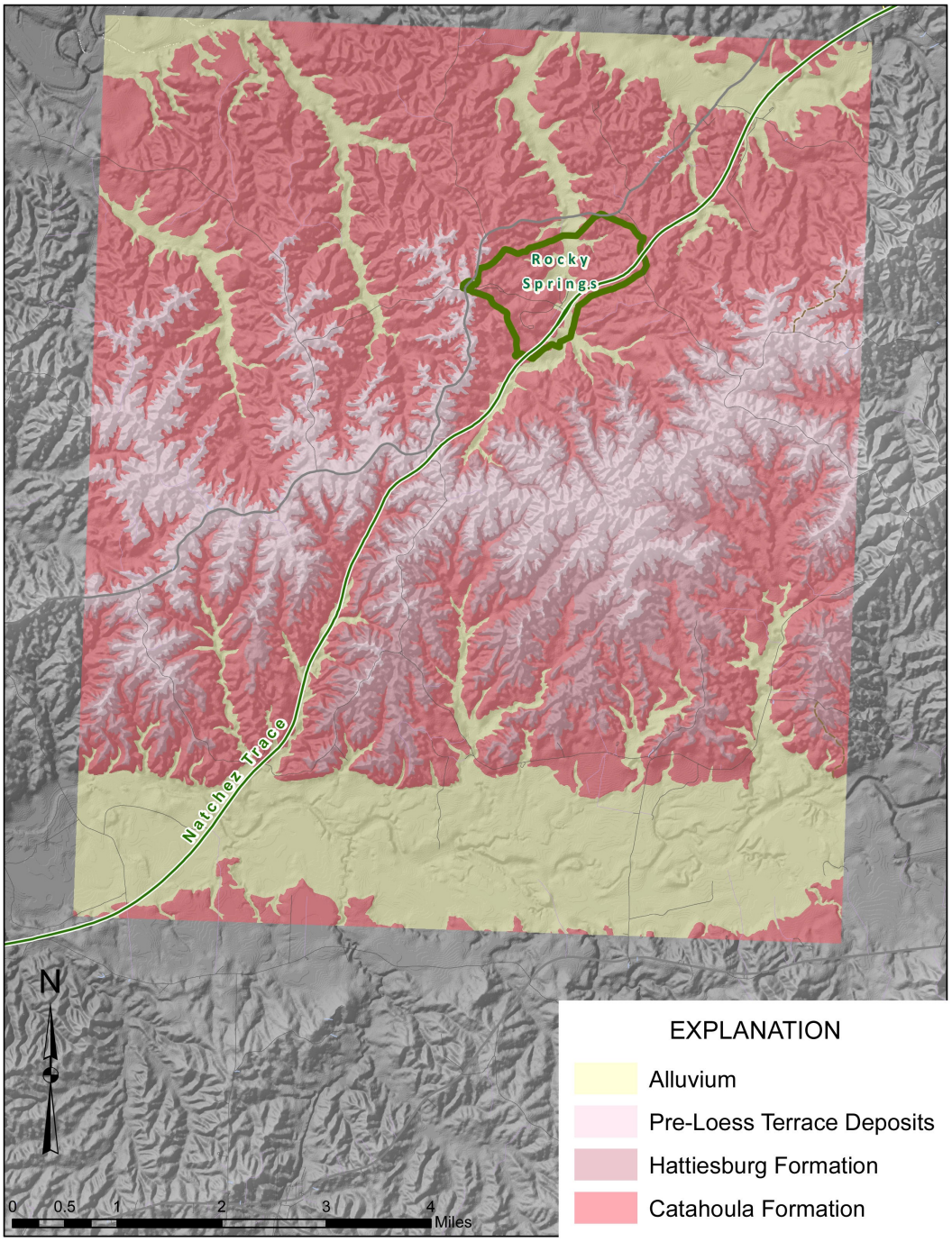


Figure 5. Rocky Springs site on the Natchez Trace Parkway as shown on the Carlisle Geological Quadrangle map (color portion of shaded relief map), Mississippi Office of Geology, Open File Report 190, by Starnes and Davis, 2004.

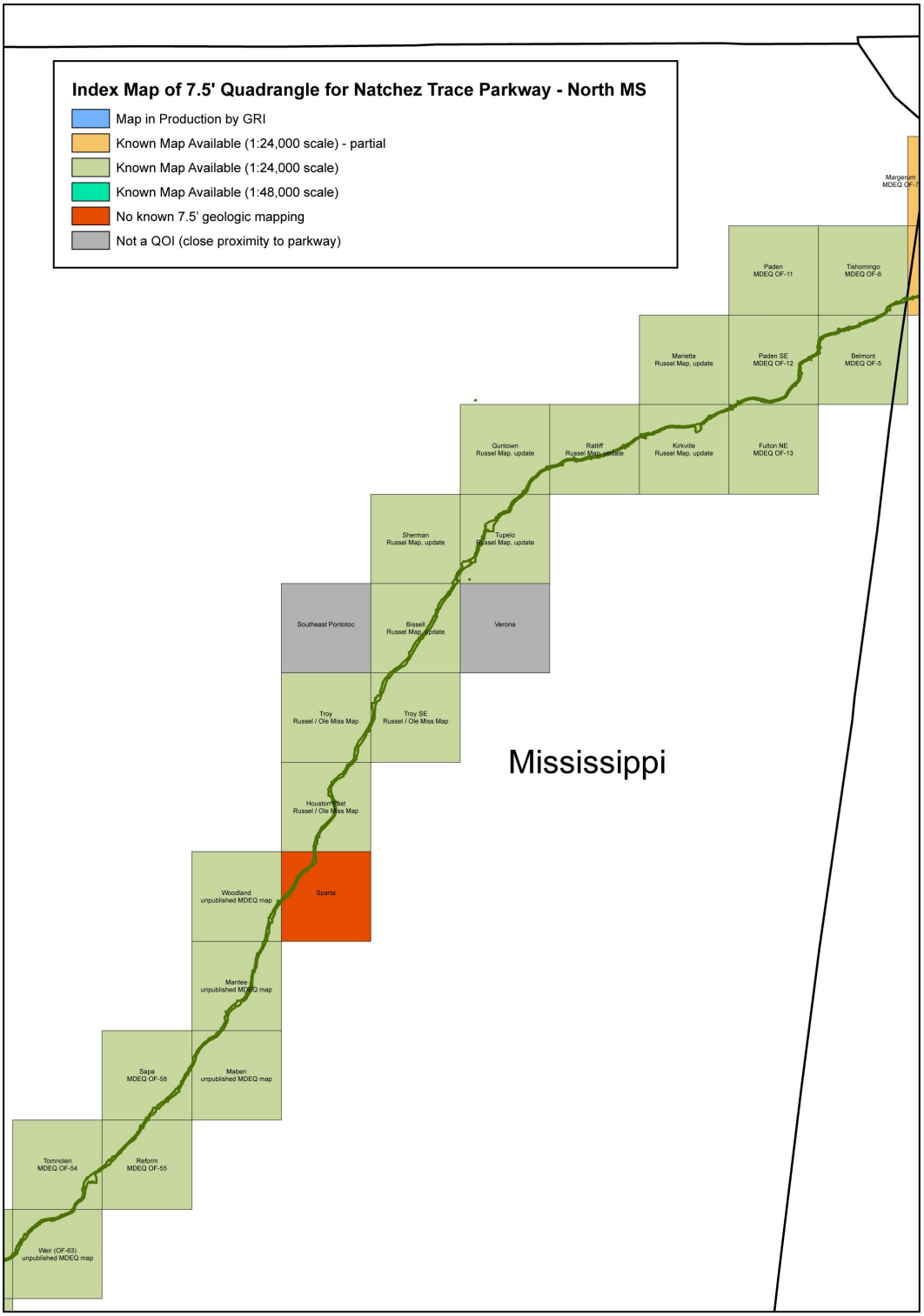


Figure 6. 7.5-minute quadrangle coverage of the Natchez Trace Parkway in northeastern Mississippi. The Jeff Busby site is in the Tomnolen Quadrangle on the western side of the second tier of quadrangles from the southern edge.

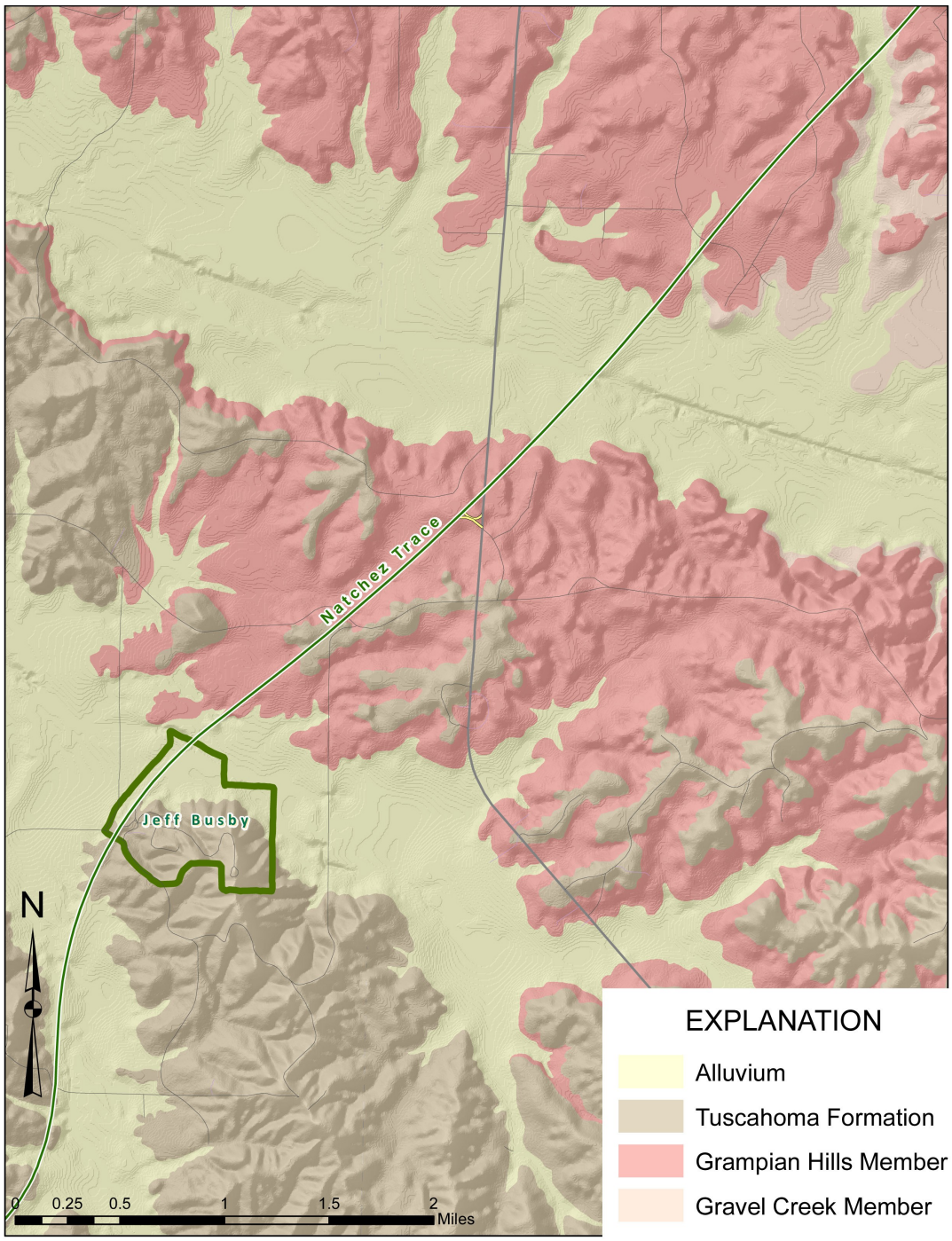


Figure 7. Jeff Busby site in the Tomnolen Geological Quadrangle map, Mississippi Office of Geology, Open File Report 54, by David Thompson, 1998, with shaded relief added. Little Mountain overlook is in the southeastern part of the park on the lower Tuscahoma Formation.

Figure 8. Little Mountain overlook (looking east) at the Jeff Busby site along the Natchez Trace Parkway. Picture was taken in July of 1973.

The National Park Service meetings in Mississippi successfully accomplished the goal of developing a plan to complete a geologic map product for VNMP and NATR.

Volume 14 Issue 5, pages 1–2 May 2017

MDEQ Staff Changes

Michael Bograd

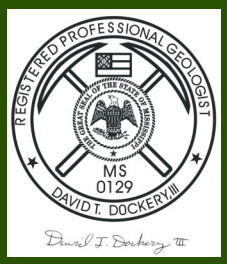
After more than 46 years of service to the state, State Geologist and Head of MDEQ's Office of Geology, Michael Bograd is retiring June 30. Bograd has served in these positions since 2004, and is also a long-standing member of the Mississippi Environmental Quality Permit Board.

"I have found MDEQ a good place to work. Its responsibilities are very important to the economy, health, and welfare of the citizens of Mississippi, and the work is interesting and intellectually stimulating. I have enjoyed working with a great group of professional, dedicated colleagues through my years with the Geological Survey / Bureau of Geology / Office of Geology," said Bograd.

Immediately after graduation from Mississippi State University in 1971, Bograd worked for the Geology Section of the Gulf Coast Research Laboratory. On January 1, 1972, he started as the junior geologist at the Mississippi Geological Survey, which in 1979 became the Bureau of Geology and Energy Resources of the Mississippi Department of Natural Resources and in 1989 the Office of Geology and Energy Resources of the Mississippi Department of Environmental Quality.

Helping students identify fossils in gravel.

This 1989 photo of Michael Bograd shows a sample of Selma chalk from the quarry at Artesia, where it was mined for cement manufacture. The hole is from a borehole in the quarry. The boulder dissolved away over several months. The Selma chalk outcrop belt has been studied in Mississippi for two proposed hazardous waste disposal facilities, and was the site of Mississippi's proposal for locating the Superconducting Super Collider in the 1980s.



Geological Finds at the Rankin Trails Park and Amphitheater

David T. Dockery III, RPG, James E. Starnes, RPG, and Tyler Berry, RPG, Office of Geology

The Rankin Trails Park and Amphitheater is a $4.2 million renovation of Brandon's Shiloh Park on the property of the old Marquette Cement Manufacturing Company's quarry and plant site (Figure 1). The renovation includes a pavilion, several state-of-the-art baseball fields, walking and biking trails, and the new Marquette Amphitheater, all projects requiring excavation and bedrock exposure. This site is also a fossil locality designated as Mississippi Geological Survey (MGS) locality 98. Thus, it should come as no surprise that recent construction at this site uncovered jackhammer-hard bedrock, limestone, and fossils. Figure 2, on the next page, shows the quarry wall of the old Marquette quarry which was a favorite fossil collecting site for the Mississippi Gem and Mineral Society. The front office of the Marquette Company on site included a display case with fossils from the quarry. One of these fossils was a limestone block with the cylindrical cast of a palm tree trunk, which is now in the *Stories in Stone* exhibit at the Mississippi Museum of Natural Science.

Figure 1. Design concept for the Rankin Trails Park and Amphitheater as posted on October 14, 2014.

Figure 2. Glendon Limestone at the Marquette Cement Manufacturing Company's quarry at Brandon, Mississippi. Picture is from *The Geology of Mississippi*, p. 458, fig. 770; it was taken in July of 1978.

In 2016, when Office of Geology staff arrived at the Rankin Trails construction site, they found construction workers and supervisors showing off fossils they had collected (Figure 3). The site, therefore, was a well-rounded opportunity for an educational geology field trip for Geology staff and Millsaps College students as it combined stratigraphy, fossils, and karst limestone associated with the lower ledge of the Glendon Limestone as shown in Figure 4. Just below the Glendon Limestone, and near the top of the underlying Marianna Limestone, was a foot-thick bed of bentonite. Bentonites in the same geologic formation were once commercially mined in Smith County, Mississippi, for various industrial uses. Such bentonite beds are weathered volcanic ash deposits derived from volcanic eruptions as far west as New Mexico and Colorado. Bentonites often contain crystals of biotite and sanidine that can be radiometrically analyzed to find the age of the eruption event in millions of years. For this reason, samples of the Rankin Trails bentonite bed were collected with the help of a company backhoe (Figure 5). In Figure 6, company supervisor David Rattcliffe shows his fossil crab specimen to Millsaps College students and professors on a class field trip.

Figure 3. Left, supervisor David Ratcliffe shows a fossil heart urchin and two shark teeth he found at the Rankin Trails construction site. Picture was taken on October 3, 2016. Right, four views of the heart urchin *Schizaster americanus*, which David Ratcliffe donated to the Mississippi Museum of Natural Science.

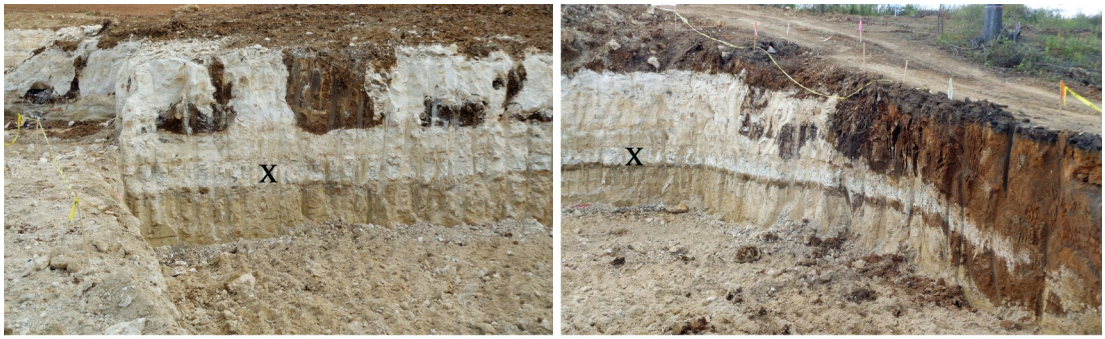


Figure 4. Karst caverns in the lower ledge of the Glendon Limestone filled with clay from the overlying Bucatunna Formation. Xs mark the location of the bentonite bed below the Glendon Limestone. Pictures were taken on October 27, 2016.

Figure 5. Left, trackhoe operator uncovers bentonite bed for sampling. Right, Tyler Berry (at left) and a Millsaps student collect bentonite samples. Pictures were taken on October 27, 2016.

Figure 6. Left, Millsaps College Geology Department field trip to the Rankin Trails construction site. Third from the right, David Ratcliffe holds a fossil crab specimen. Right, fossil crab *Necronectes vaughani* from the Glendon Limestone. Pictures were taken on October 27, 2016.

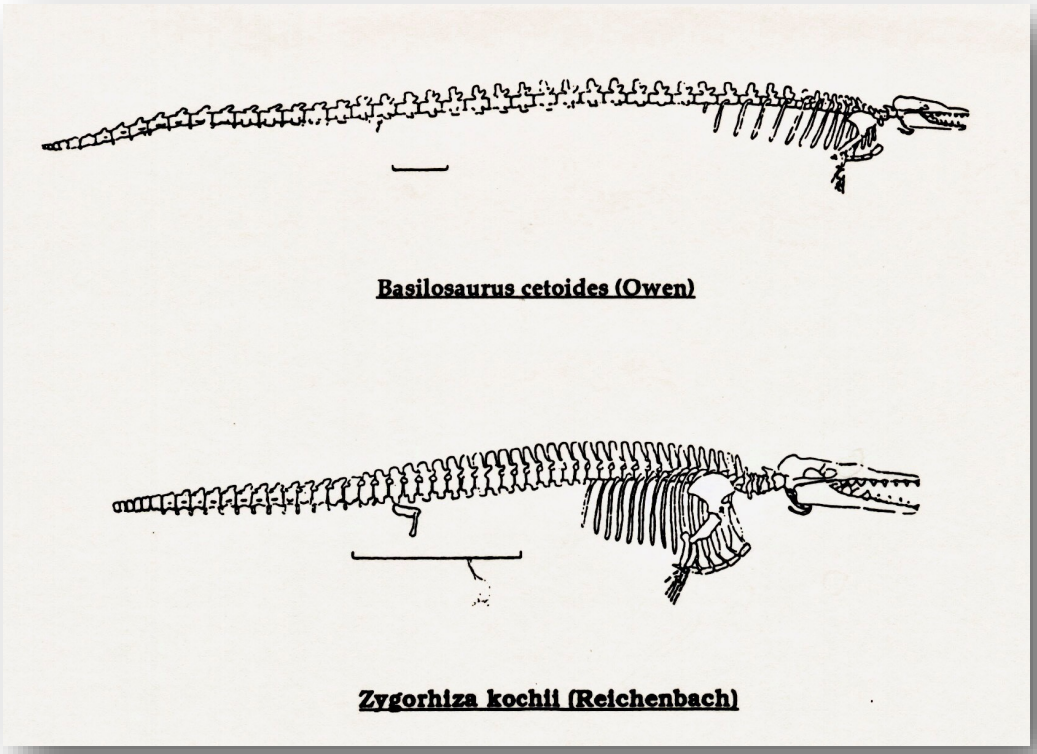
Burrowing fossil clam *Panopea oblongata* in life position in limestone.

Volume 14 Issue 6, pages 1-3 June 2017

Excavation of a Fossil Whale Skeleton by MDEQ in Scott County

By James E. Starnes, RPG, and Paul Parrish, RPG, Office of Geology

Last fall, a Scott County resident hunting for Civil War artifacts discovered fossil bones protruding from the Yazoo Clay at the edge of a field near Sherman Hill. This part of the Yazoo Formation is known for the preservation of extinct early toothed-whale fossils, known as archaeocete whales. The fossil whale is the official State Fossil of Mississippi, and these whales lived at a time called the Late Eocene, some 34-40 million years ago, when higher sea-levels covered much of Mississippi. A largely complete skeleton of a 65-foot long fossil whale called *Basilosaurus cetoides* was excavated near this area in 2002. A complete reconstruction based on that fossil material hangs in the atrium of the Mississippi Museum of Natural Science today.



Top photo: Two intact whale vertebrae encased in Yazoo Clay.

Bottom photo: Madison Kymes with a freshly excavated vertebra centrum.

The bone material initially excavated by the collector indicated the fossil whale to be the remains of the smaller, 16-foot long, dorudont whale named *Zygorhiza kochii*. The most complete specimen of this species was collected from the Moody's Branch Formation on Thompson Creek in Yazoo County. This important specimen is also on display at the Mississippi Museum of Natural Science's Stories in Stone exhibit.

Last month, a team of scientists and engineers from MDEQ's Office of Geology and Office of Land and Water Resources was assembled to conduct a careful excavation on this newly discovered specimen. The team led by geologists James Starnes and Paul Parrish included MDEQ staff Andrew Newcomb, Mary McKay, Kristian Macias, Madison Kymes, Lindsey Henley, Johnathan McKinnon, Austin Brister, Andrew Cummings, Kristen Sorrell, Rachel Harris, and also included the discoverer Matthew Giammalvo and his friend Sid Champion.

Photo: Delicate excavation of the fossil remains from the dig site by MDEQ staff.

Many fossil vertebrate species are known only from a few bones or teeth, so to find a partial skeleton of an extinct whale is significant. After two weeks of excavation, the team recovered a number of vertebrae, rib bones, sternal segments, most of the limb and flipper bones, hyoid, a number of elements of the skull and lower jaws, including numerous teeth and even the delicate ear bones. The fossil bones lay scattered about the excavation like a jigsaw puzzle because of what happened to the carcass after it came to rest on the deep ocean floor. As the whale's body decayed, it became feeding ground for fish and sharks until there was no meat left on the bones. We know this because of the numerous fish and shark fossil bones and teeth that are found in direct association with the whale bones. This phenomenon, known as a "Whale Fall," occurs today as an oasis of biological activity in an ecosystem dependent on whale carcasses on an otherwise largely barren deep ocean floor.

The Sherman Hill specimen has been donated to the State collections at the Mississippi Museum of Natural Science for scientific preservation and study. The findings will be presented this spring at the Mississippi Academy of Sciences annual meeting. Plans are also being made for an educational display and exhibit at the public library in Forest to highlight this exciting find and to educate the public about Mississippi's rich prehistoric past and fossil record. More information about Mississippi's geological past is available at: http://bit.ly/2oQBW4j.

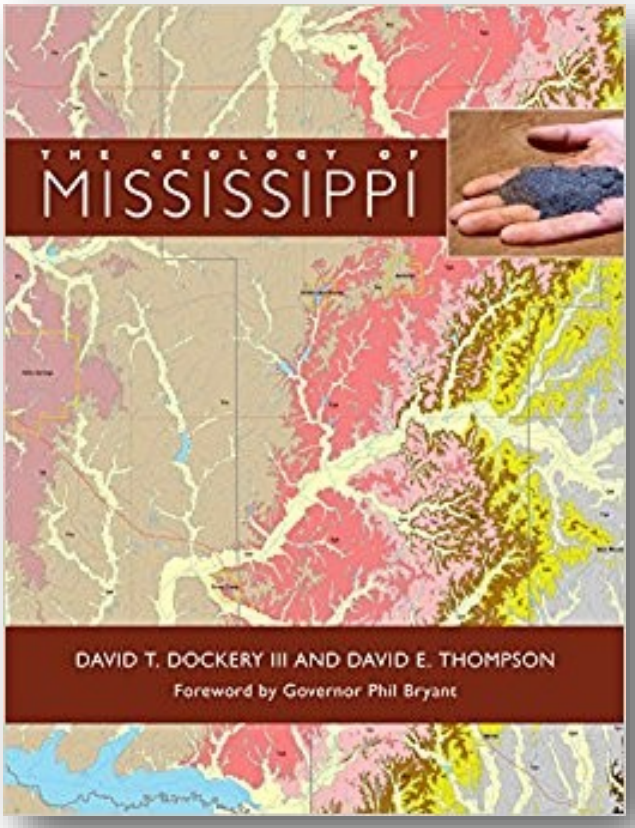
Staff Changes

Office of Geology

David Dockery

David Dockery was recently selected as head of the Office of Geology and the State Geologist replacing Michael Bograd who retired June 30. David worked for the Mississippi Geological Survey, now the Office of Geology, from 1969 to 1977 as a summer worker during his undergraduate and graduate school years helping with work on the Rankin, Smith, and Wayne County Geology bulletins and publishing a book on fossils from the Jackson Group in 1977. David has a B.S. degree in Geology from Mississippi State University, an M.S. degree in Geology from the University of Mississippi, and a Ph.D. in geology/paleontology from Tulane University, with studies at Duke University as part of a Tulane-Duke-Emery Ph.D. consortium.

From 1978-2017, he served as Director of the Surface Geology Division of the Office of Geology. Under his direction, the division has published the Clarke, Newton, and Tishomingo County Geology bulletins, 160 site-specific, 7.5-minute geologic quadrangle maps, and numerous other publications. *The Geology of Mississippi* by Dockery and Thompson, a 751 page, hardbound book with 1099 figures in color, was published in April 2016 by MDEQ and the University Press of Mississippi. Dockery has also served as an adjunct professor in the Geology Department at Millsaps College, Hinds Community College at the Rankin Campus, and at the Tulane Madison Campus. He is a native of Jackson, and is a Registered Professional Geologist in Mississippi.



Volume 14 Issue 9, pages 17-19 October 2017

The Wiggins Uplift, a Large Chunk of Appalachian Piedmont Terrain Beneath Jackson County

David T. Dockery III, RPG, and Paul Parrish, RPG, Office of Geology

The Permian Period, some 280 million years ago, was a time of continental collision along the North American Eastern Seaboard and eastern Gulf of Mexico. The northern supercontinent Laurussia (containing North America, Europe, and Asia) converged with the southern continent Gondwana (containing Africa, South America, Australia, Antarctica, and India) to form one large continent named Pangea (Ancient Greek for "all lands"). Suturing the new continent was a chain of collision-created mountains that make up today's Allegheny and Appalachian Mountains. The name of this Permian-age mountain building event is the Alleghanian orogeny (Figure 1). According to Wikipedia: "Evidence for the Alleghanian orogeny stretches for many hundreds of miles on the surface from Alabama to New Jersey and can be traced further subsurface to the southwest" (i.e. southeastern Mississippi and southwestern Alabama). At the core of this continental collision is a migmatitic gneiss, a metamorphic rock at the highest end of the metamorphic spectrum. Such metamorphic rocks make up portions of the Piedmont Mountains, which run along the eastern flank of the Appalachian Blue Ridge or Valley and Ridge Mountains.

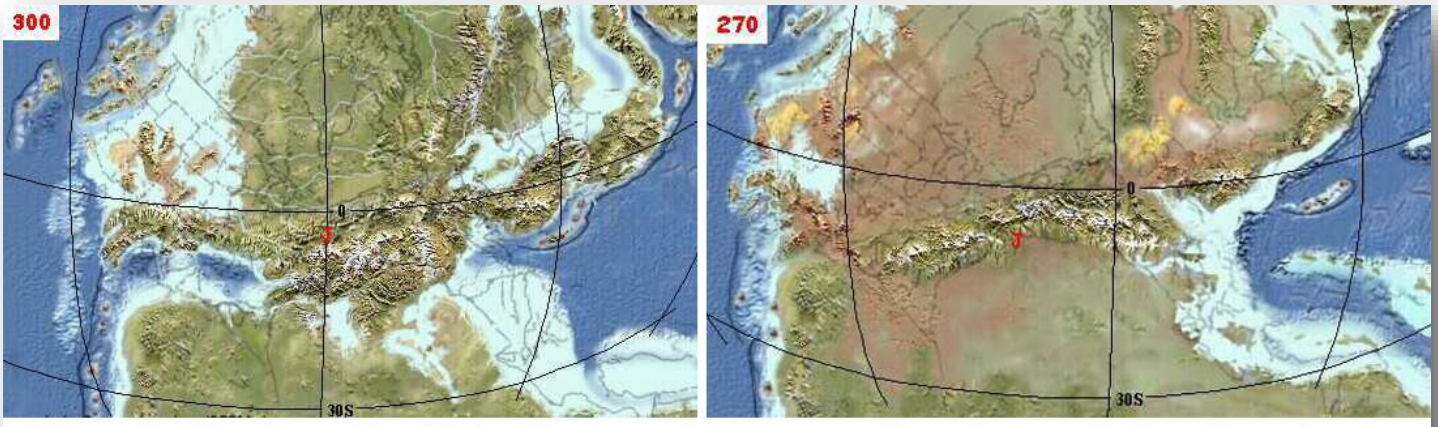


Figure 1. Continental collision between the supercontinets Laurassia (north) and Gondwana (south) at 300 and 270 million years ago. Image created by the Paleomap Project.

Figure 2 shows the migmatitic (with melted and recrystallized zones) Old Lyme Gneiss from the Piedmont of southcentral Connecticut. Figure 3 shows a core of Alleghanian-age migmatitic gneiss from an oil exploration well drilled into the Wiggins Uplift in Jackson County, Mississippi. This core comes from a depth of 18,678 to 18,689 feet below the surface and has a radiometric age of 282±14 million years old. Four other wells that reached basement rock on the Wiggins Uplift had radiometric ages ranging from 275 to 300 million years old.

Figure 2. USGS geologist Greg Walsh explaining an outcrop of the migmatitic Old Lyme Gneiss in south central Connecticut on a field trip of the 2012 Northeastern Section meeting of the Geological Society of America.. The parent rock is of NeoProterozoic (Precambrian) age. The metomorphic folding and migmatization occured about 285 million years ago during the Permian Alleghanian orogeny.

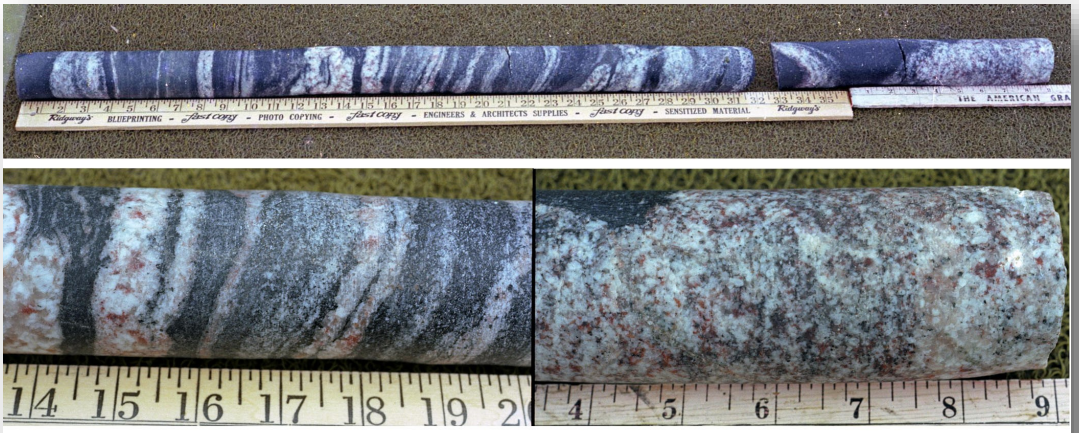


Figure 3. Permian migmatitic gneiss (282 million years old) from the Wiggins Uplift in the Champlin Oil Company #1 International Paper Company wildcat well in Jackson County. This portion of an eleven-foot core was taken from 18,678 to 18,689 feet below the surface. The bottom of the core is to the right and enlarged in the lower view. Pictures were taken in January 1981.

County (Figure 4) and the buried Appalachian Valley and Ridge Fold Belt under Lauderdale County are separated by an intervening basin named the Mississippi Interior Salt Basin. Mississippi's Interior Salt Basin formed by rifting during the breakup of Pangea, the same rifting that created the Atlantic Ocean and Gulf of Mexico, and which moved continents to their present position. In the early stage of rifting, the Wiggins Uplift was moving southeast with North Africa, but was stranded under Jackson County when the focus of rifting switched to the Atlantic Ocean and Gulf of Mexico.

So, what does all this mean for us? Stranded blocks of Piedmont terrain beneath the coastal counties of Mississippi and Alabama anchor the shoreline against land loss due to subsidence. If not for the bedrock geology of the coast, the erosion of Mississippi's coastal marshes due to sea level change would be worse.

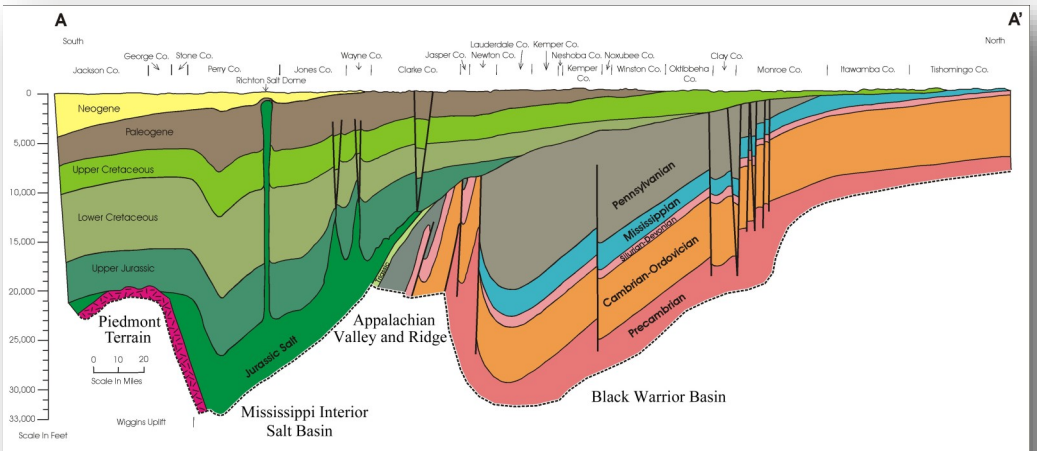


Figure 4. Cross section of eastern Mississippi from the Tennessee line (right) to Horn Island (left), showing the basement structure of the state.

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Mississippi's River Basin Geology

David T. Dockery III, RPG, and Barbara Yassin, Office of Geology

The bedrock geology of Mississippi is a controlling factor in the distribution of soil types, physiographic provinces, ecoregions, and river basins in the state. This in turn had a significant impact on the development of agriculture, population settlement, the location of industry, and many other factors in the state's history.

Figure 1 is a graphic depiction of cuestas in the Gulf Coastal Plain from Nevin Fenneman's (1938) *Physiography of Eastern United States*. Cuesta is a Spanish word for "flank or slope of a hill." In geology it specifically refers to outcrop belts that form a gentle slope down structural dip (in Mississippi to the west and south) and a steep opposing slope where strata are eroded in their up-dip limits. In Mississippi, the steep slopes of the Wilcox Cuesta face the Tombigbee River Basin. The cross section of Figure 1 is representative of the geology along the Mississippi-Alabama state line from Tennessee to the Gulf Coast. The two highest hills in Mississippi are Woodall Mountain (806 feet above mean sea level) on the Fall Line Hills Cuesta in the Tennessee River Basin and Mt. Lebanon (790 feet) on the Ripley Cuesta (Pontotoc Ridge) in the North Independent Streams Basin. Prairie low lands such as the Black Belt, Flatwoods, and Jackson Prairie develop on chalk and/or clay strata with low permeability and soils that do not support steep slopes and are more prone to erosion due to increased runoff.

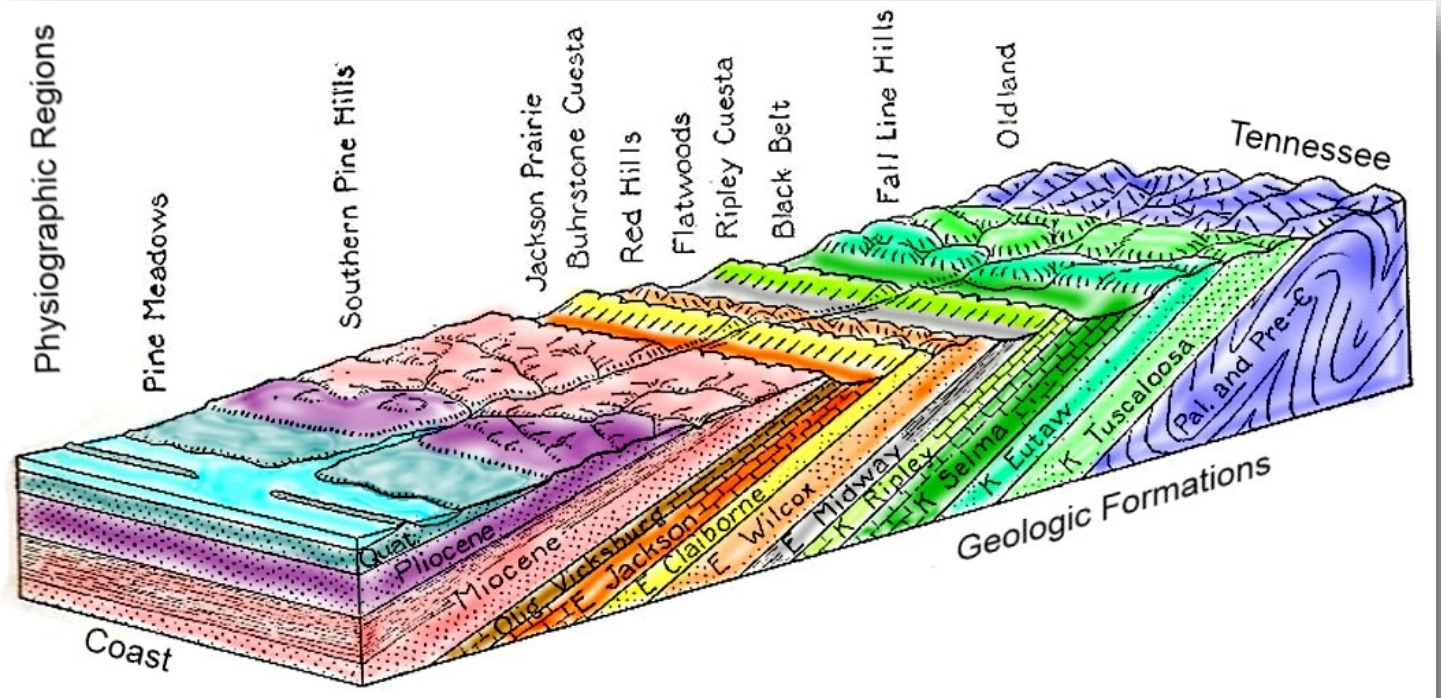

Figure 1. Cuestas in the Gulf Coastal Plain from Fenneman (1938).

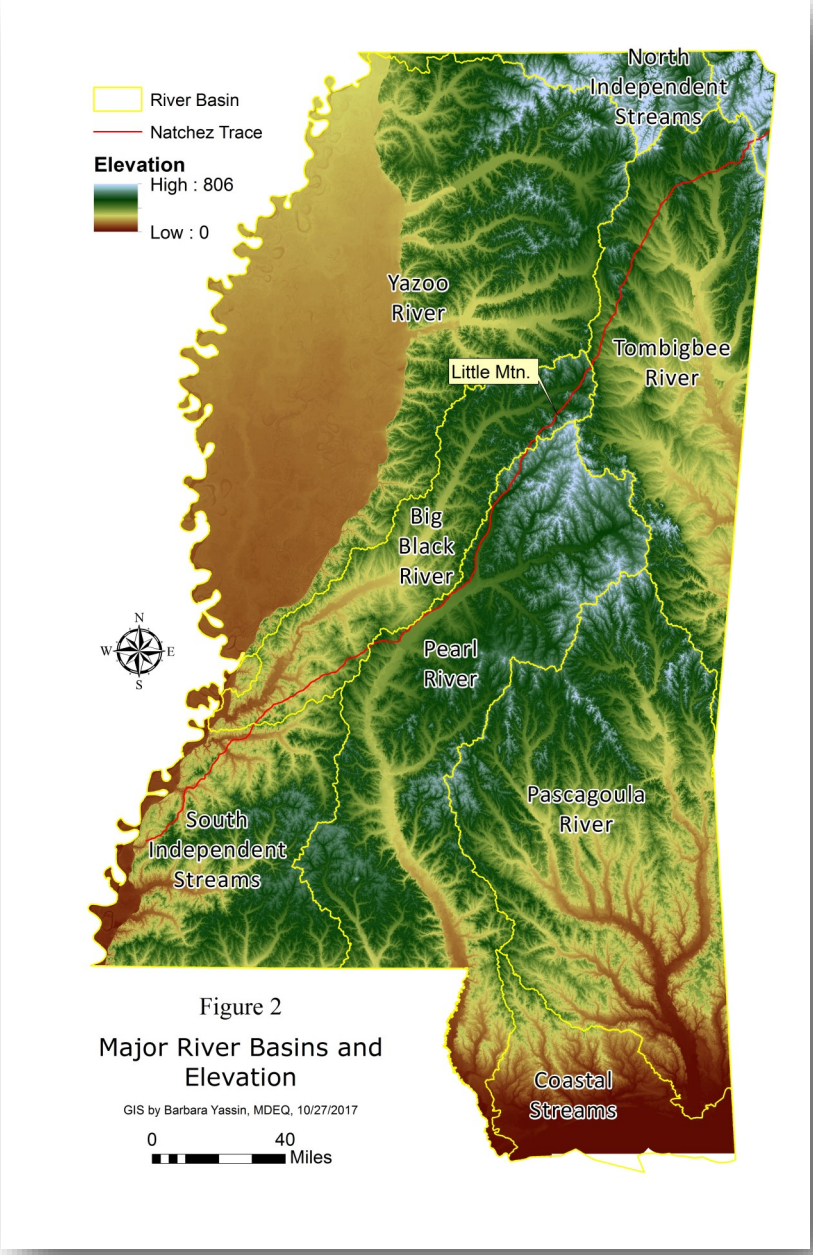

Figure 2

Major River Basins and Elevation

Figure 2 is a relief map of Mississippi with the divides of major river basins. The five largest river basins in order of rank include the Yazoo River Basin, draining 13,355 square miles within the state, the Pascagoula River Basin at 9,600 square miles, the Pearl River Basin at 8,700 square miles, the Tombigbee River Basin at 6,100 square miles, and the Big Black River Basin at 3,400 square miles. The divide between the Tombigbee River Basin and the basins of the Pascagoula, Pearl, and Big Black rivers is a ridge of high ground in elevation-coded colors of dark green and white with white creating a snowcapped appearance to the highest elevations. This high ground drops to mid-level light-green-coded elevations along the divide of the Tombigbee and Yazoo river basins before rising northward to white elevations along a ridge known as the Pontotoc Ridge extending southward from the North Independent Streams Basin. Across the low saddle, the divide jumps from the Paleocene Wilcox Cuesta across strata to the Cretaceous Ripley/McNairy Sand Cuesta. The low divide is associated with the curious fact that flood plains of the Yazoo and Tombigbee river basins in northern Mississippi are lower in elevation than the Big Black, Pearl, and Pascagoula in central Mississippi.

Figure 3 is a composite Mississippi map depicting surface geology, hillshade relief, and major river basins. Labelled on the map is the location of Little Mountain in Jeff Busby Park on the Natchez Trace Parkway, a road that follows the divide of the Big Black and Pearl River divide northward to that point. Little Mountain (Figure 4) is an outlier of the high ground of the Wilcox Cuesta at the triple basin junction of the Big Black, Pearl, and Tombigbee river basins. The low elevations of the Tombigbee River Basin are on the soils of the Black Belt (Figure 1), soils that develop from easily weathered chalks and marls in the Selma Group. Figure 5 is a LiDAR bare earth hillshade relief image showing rugged terrain along the western margin of the Tombigbee River Basin and at the triple basin junction with the Pearl and Big Black river basins. In the east, the Tombigbee River Basin is characterized by low prairie land; in the west, the upper Pearl and Big Black river basins are characterized by higher elevations and greater relief. This varied terrain correlates with the varied bedrock geology beneath it.

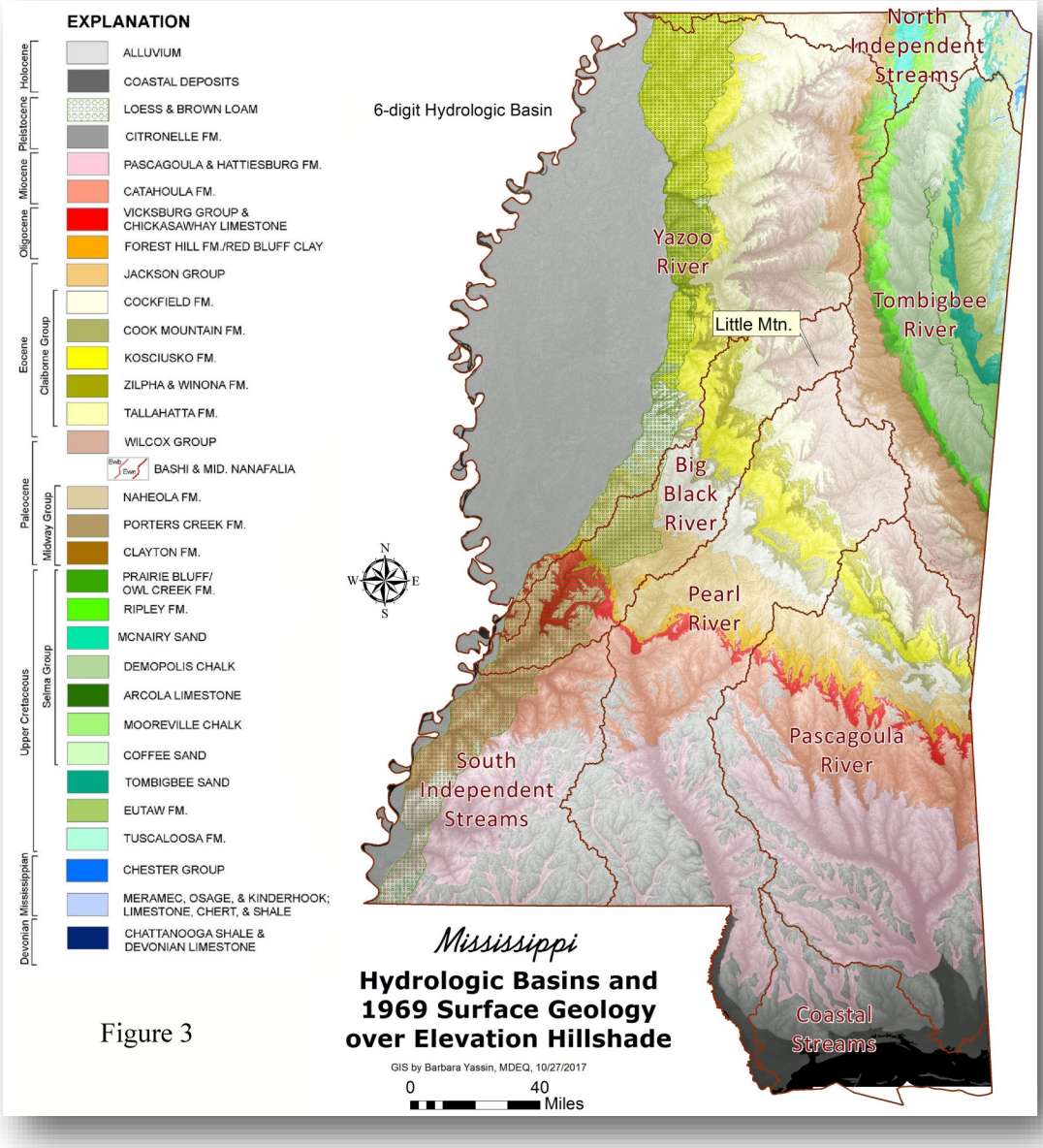

Figure 3

Figure 4. View to the northeast from the Wilcox Cuesta at Little Mountain in Jeff Busby Park on the Natchez Trace Parkway in the upper reaches of the Big Black River Basin. Picture was taken in July of 1973.

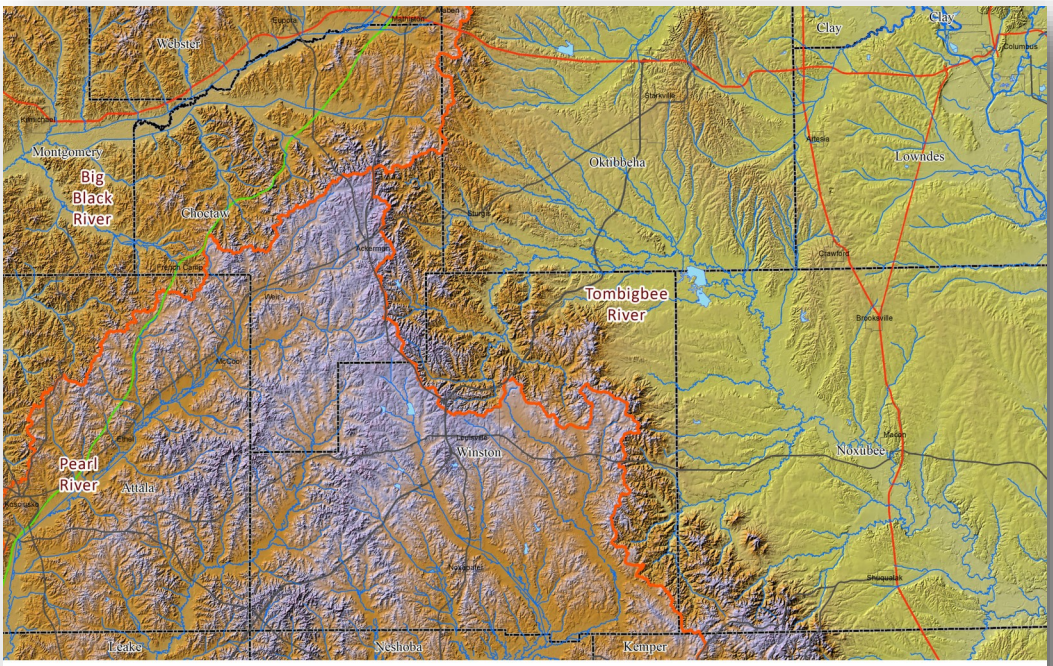

Figure 5. LiDAR bare earth hillshade relief map showing the triple basin junction of the Tombigbee River Basin (east) and the Pearl and Big Black river basins (west). The Natchez Trace Parkway is in green. Elevations are coded with golden yellow for low, brown for intermediate, and lavender for high.